THE MODEL ENGINEER

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JULY 23rd 1953
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THE MODEL ENGINEER

EVERY THURSDAY

Volume 109 - No. 2722

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Our Cover Picture

This week we reproduce a photograph of Mr. J. Bagshaw's ½ in. scale model of a "Fairmile B" motor launch, which was exhibited at the Northern Models Exhibition held this year in Manchester. The model was about 56 in. long and its general appearance was decidedly impressive. The proportions of the original were well preserved and for a working model the amount of deck detail which was incorporated was just right. The power unit was a twin-cylinder, side valve water-cooled petrol engine driving twin screws through a gearbox. The general layout of the plant was very neat and accessible. We would like to see this model on the lake and under power; with its generous dimensions and nice proportions it should look very realistic, and with the efficient power unit which is installed it should have a nice turn of speed. The scale of ½ in. is ideal for a craft of this size, as the resulting model can be built to the correct proportions below water as well as above.

SMOKE RINGS

An "M.E." Exhibition Reminder

THE TIME for the 'M.E." Exhibition is drawing near—August 19th to 29th inclusive, except Sunday the 23rd—and we expect that there are many clubs, societies, schools, etc., that would prefer to make up parties for visiting the show. We would remind our readers that there is a special rate of admission for parties of twelve or more; this saves waiting in the queue and ensures immediate admission on arrival at the hall, provided that due application has been made before the date of the visit.

Anyone wishing to take advantage of this concession should communicate as soon as possible with the Exhibition Manager, Percival Marshall & Co. Ltd., 19-20, Noel Street, London, W.1.

Traction Engine Rally at Witney

MR. S. J. WHARTON, of Minster Lovell, tells us that a traction engine rally has been arranged to be held on Witney Airfield, Oxon, on July 25th. There will also be a set of Fowler steam ploughing engines in steam complete with equipment. In addition, there will be a small fun fair with a set of steam gallopers and organ; three showman's Burrell engines and Mr. Wharton's own *King George VI*. Any MODEL ENGINEER readers will be welcome.

News from Bombay

WE HAVE received a long and friendly letter from Mr. P. Polson, of the Bombay Society of Model Engineers. He mentions the pride occasioned by the award of a certificate of merit to Mr. D. D. Bilimoria for a model ship, *Sea Witch*, exhibited at the "M.E." Exhibition last year. Mr. Polson adds: "This was unique because India was, for the first time, represented in the world history of model engineering, and I am mightily proud that one of my boys gave a good account of himself on an international field." We appreciate Mr. Polson's sentiments in this matter and we hope that we may have the pleasure of seeing other examples of the work of his "boys" at future "M.E." Exhibitions.

Bombay will be holding its eighth "Model Builders and Handicrafts" exhibition at the Jehangir Art Gallery, Bombay, from November 21st till December 6th next, and the Governor of Bombay has been invited to perform the opening ceremony. Mr. Polson kindly makes an offer to British model engineering traders, manufacturers, societies and model makers to co-operate in the exhibition. He realises, of course, that it will be difficult to send out actual models for sale or display; but he is sure that there will be some people, particularly manufacturers, who would like to send pamphlets, literature, photographs, etc.

Mr. Polson's address is: 23, Colaba Chambers, Colaba, Bombay, India.

A Special Appeal

THE TALYLLYN Railway Preservation Society, founded for the purpose of acquiring, preserving and operating the last narrow-gauge, steam-operated railway in the world, is strongly reminiscent of the *Titfield Thunderbolt*, but in real life. The society's report, recently published, shows that excellent progress is being made against heavy odds.

A wonderful opportunity was lately presented to it to have about two miles of derelict track relaid. This has been made possible by the chief engineer, Western Command, Territorial Army, whose unit, during their summer training, have undertaken to do the work. The society, however, has had to find the materials, costing some £1,500 which it could not afford. As a result of a special appeal, and through the efforts of members, more than half the amount has been subscribed, leaving about £650 to be obtained. Any interested readers are invited to send in contributions to either Mr. W. G. Trinder, 84, High Street, Banbury, Oxon, or to Mr. P. J. Garland, 36, Waterloo Street, Birmingham 2.

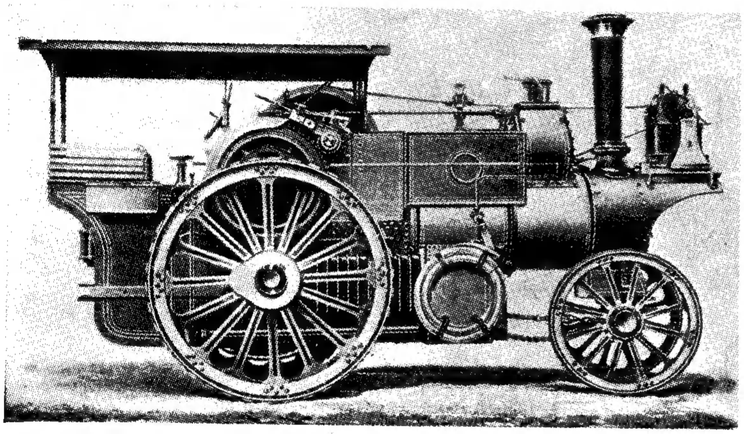
Talking about Steam—

NO. 19. SOME EARLY SHOWMAN'S ENGINES

By W. J. HUGHES

FOR various reasons, I could not quite complete the second sheet of drawings for the Fowler Showman's fittings in time for this article. However, it is hoped that the accompanying illustrations of early showman's engines will compensate for the delay, and I hope to deal with the Fowler details next time. To the enthusiast who would like to build a showman's engine, and yet wants to be "different," these old engravings may well be an inspiration.

One of the nicest model showman's engines I have ever seen was built by the late Amos Barber some twenty or more years ago; it was single-cylindered, without a canopy, and had the old type of "open-built" dynamo on the smokebox bracket. Built to $\frac{3}{4}$-in. scale, and with the typical Barber superlative finish, it was truly representative of the '90s period. The builder told me that there was a regular circle worn in the lino where it had run in the kitchen on winter evenings !



A Burrell 10 *n.h.p. showman's road locomotive, built in* 1894. *Note weather-board at front of canopy*

In the Beginning

The history of the use of steam in the fairground is most absorbing, and would easily fill a book—or several, if one went into adequate detail ! In general, the forerunner of the showman's road locomotive was the portable engine, and at first the showman would hire an engine from a local farm, brickworks, or timber yard, to drive his roundabout (otherwise hand-operated) by means of a flat belt. Later, however, many showmen purchased their own portables, but, of course, these had to be hauled from one pitch to another, like his other vehicles, by means of horses. This was in the '60s.

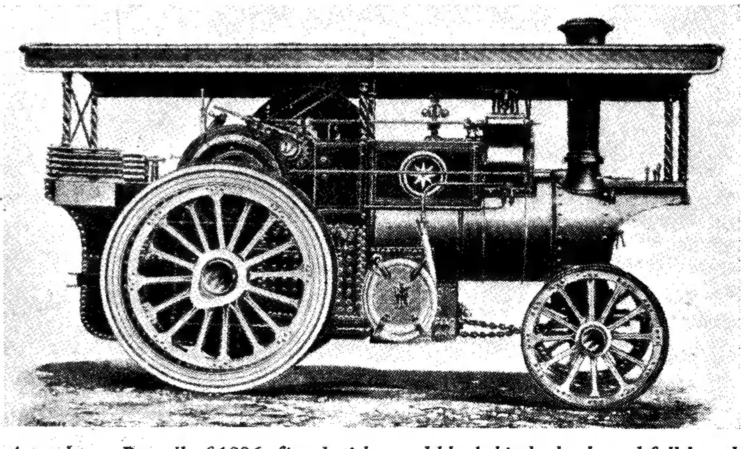
Then Frederick Savage introduced his centre engine, which was built into, and formed the foundation of, the roundabout itself, but these, too, had to be hauled about by horses. The load was heavy, and gradually the traction-engine came to be used, at first hired locally, but later owned by the showman himself.

It is on record, however, that as early as 1859, one enterprising circus proprietor was using a "road steam-engine" to move his show. This was probably Jim Myers, who was certainly using a Bray traction-engine in the '60s. Bray's traction-engine was of a most interesting design, but as I propose to deal with it later in this series, we will not go into detail in this résumé.

The First Showman's Engine

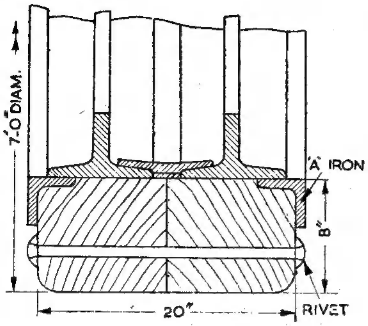
The first engine to be built specially for any showman, of which I have any record, was built by McLaren's of Leeds for Geoghegan of Salford, Lancs. This was in 1879, and six months or so later the same proprietor purchased another McLaren.

In 1881, McLaren's built another engine for circus-owner Jim Myers, whom we have already noticed, the engine bearing the unusual name of *Sir Robert-le-Diable*. I have no



A ten-horse Burrell of 1896, *fitted with wood-block hind wheels and full-length canopy*

record of the mechanical details of these engines, but probably in general design they were of the ordinary traction type; McLaren's had only then been in existence three or four years.



Construction of Burrell wood-block hind wheels

Possibly during the '80s other engines were built for other showmen, but the next in my own records is a single-crank compound Burrell, built for Jacob Studt, of Pontypridd, in 1899. This had no springs and no canopy.

In the same year, or early in 1890, the same well-known proprietor took delivery of a second Burrell, this time mounted on springs and with a half-canopy. The front end of this canopy was supported by a weatherboard similar to that of railway locomotives of the period, with two circular glazed lookout windows in it.

This second engine had a dynamo bracket mounted on the smokebox, but for some time it worked without the dynamo, being used merely for haulage. The wheels were steel-straked, and a belly-tank was fitted to allow of longer journeys without taking on water. Nine or ten wagons and vans made a normal train for this engine, and incidentally this was quite legal until 1898, when the new Locomotives Act reduced the permitted load to three wagons or vans and a water-cart, except by consent of local councils. (Some of the latter did allow up to four wagons plus a water-cart.)

Probably the second Studt engine was very similar in appearance to that shown in the illustration, which is reproduced by kind permission of *The Engineer*, from the issue of that journal dated October 26th, 1894. The general description is the same—two-speed gear, steel-straked wheels, half-canopy with weatherboard, single-crank compound, and dynamo on smokebox bracket. The engine illustrated, however, is of 10 n.h.p., whereas the other was 8.

At the Crystal Palace

The next engraving shows a ten-horse engine of 1896, and is also reproduced by permission of *The Engineer*. The caption says that the engine is one of thirty-five supplied to leading showmen, that it will indicate 50 horse-power, and haul 50 tons " through any part of this country." The water supply lasts for from nine to twelve miles at speeds of from four to six m.p.h.

The hind wheels, which are 7 ft. in diameter and 20-in. wide, are to F. Burrell's patent, with oak-block rims. These are set endwise of the grain, and supported by angle-irons and half-round wrought-iron rings each side, with a rivet through each block from side to side, as shown in the cross section. The account goes on to say : " It is mounted on springs—Burrell's patent system, which has now been applied to over 300 engines, and stood the test of eight years. The brass fittings shown in the engraving are in accordance with showmen's requirements."

In the same year at the Crystal Palace, Burrell's exhibited a 6 h.p. compound road-locomotive weighing 7 tons, not sprung, but with their double-geared drive system; that is, a " dead " hind axle with each wheel independently driven, and compensating gear on the countershaft.

Another exhibit, to quote *The Engineer* of June 26th, 1896, was a showman's road locomotive (one of several)—" a very fine engine of 10 horse-power nominal, being fitted with a steam brake, the long brake blocks of which act on the inside of an angle steel ring inside the large road wheels, and nearly of their diameter, the rings being turned inside.. The brake blocks act on both wheels, with a leverage of about 3 to 1——."

The brake was very powerful, with a piston of 7 in. diameter, and a second brake of the ordinary type was fitted to the compensating gear-ring, so that either or both could be used at will.

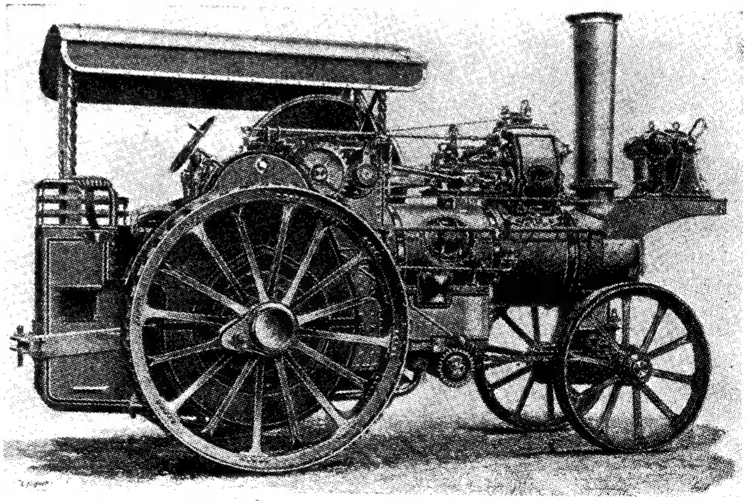
Early Fowler Engines

As I mentioned in my last article, the first Fowler showman's engine proper had its dynamo mounted on a platform above the motion, and friction driven from the flywheel. This engine was No. 6926, and was built for Francis Baily of Battersea in 1894. After one season's use the dynamo was removed to a smokebox bracket because of the oil problem.

In that article I illustrated a Fowler heavy traction-engine fitted with a dynamo, reproduced from the 1895 catalogue.

An earlier Fowler was that supplied to Bostock & Wombwell's menagerie in 1892, but this was an ordinary single-cylindered general-purpose engine of 6 n.h.p. It had two speeds, large and wide hind wheels, steel-straked, and was fitted with a governor, and with a copper-topped chimney.

Another Fowler engine of 1895 is now illustrated, and again I am indebted to *The Engineer* for the engraving.

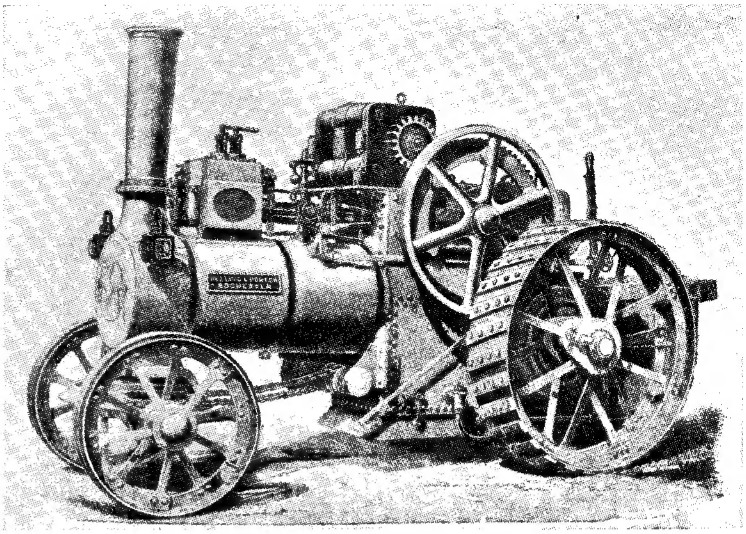


Fowler showman's engine of 1895, *with Marshall and Wigram's patent valve gear.*

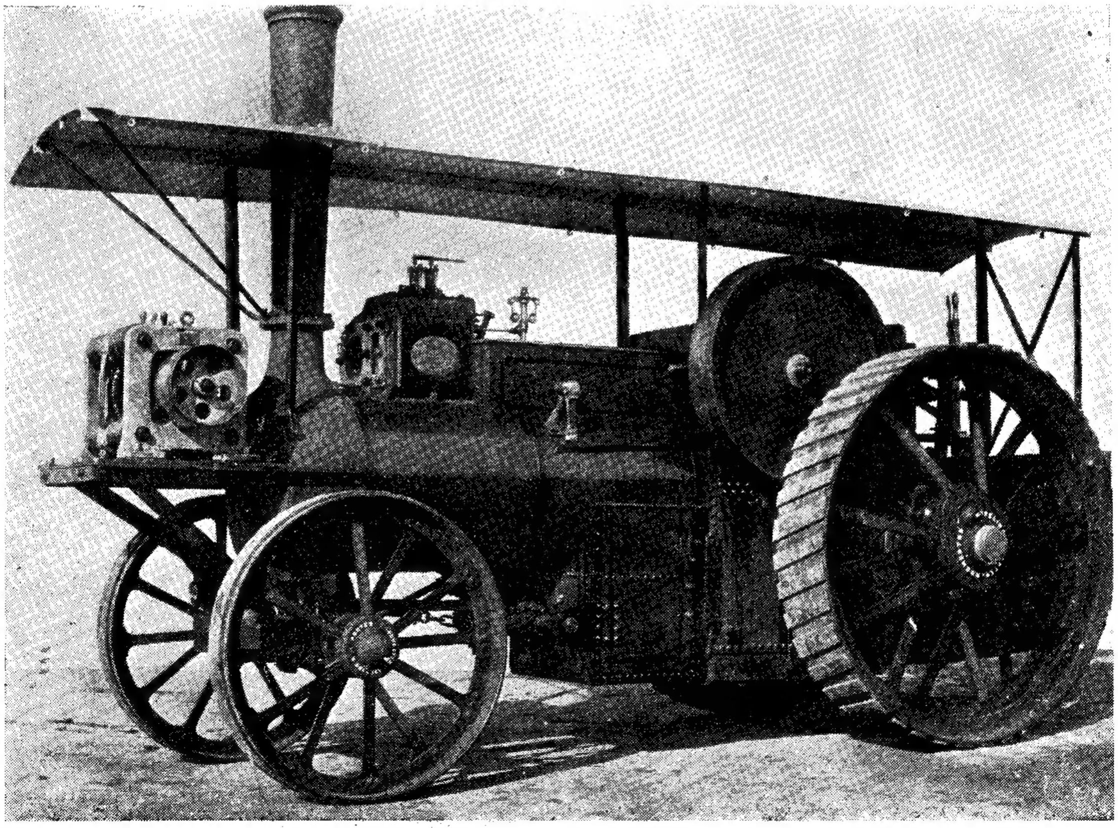
This road locomotive of 8 n.h.p. was at the Darlington show of the Royal Agricultural Society; it was mounted on springs, and on test at 150 p.s.i., it indicated 65 h.p., with a b.h.p. of 60. In another test it had no difficulty in pulling 32 tons in fast gear up heavy gradients. The performance in low-gear is not recorded.

The chief novelty in this locomotive was the new arrangement of cylinders and valve-gear, constructed under Marshall and Wigram's patent. In this gear, both cylinders were controlled by a single piston valve, with a single set of link motion, " thus doing away with one half the number of eccentrics and gear usually required and saving much wear and tear."

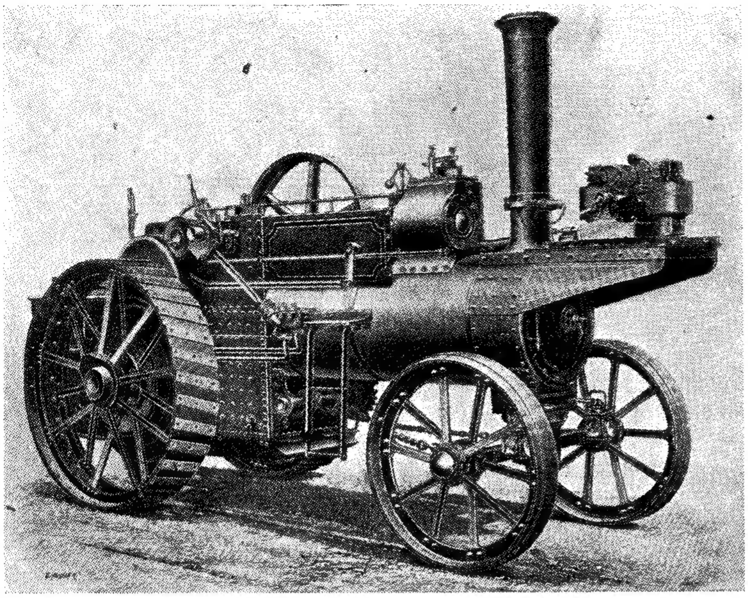
This was the first time the gear had been exhibited, but similar engines had been in use for nearly four years. Several users, it was stated, spoke highly of the engines as running quietly, using less fuel and grease, pulling heavier loads, costing less to maintain, and much liked by the men in charge.



Aveling and Porter road locomotive of 1890, *with dynamo mounted over the motion*



A large Aveling road locomotive of 1896 ; *note neat fitting of belly tank*



Showman's road locomotive of 1896, *by Ransomes, Sims and Jefferies, of Ipswich*

The cylinders were 6½ in. and 11¼ in. by 12 in., and in practice the usual sideplates were fitted to conceal the motion-work; they are omitted in the engraving to show the valve-gear.

An engine of this type would make a *very* unusual model; it could be built largely to my blueprint No. T.E.5., which it closely resembles, and the details of the valve could be looked up through the Patent Office.

Aveling and Porter

Aveling and Porter were early in the field with an engine for generating electricity, although the example shown was built actually for military service in 1890.

As will be seen, the dynamo is mounted on a platform fitted over the motion, and is driven from a large spur-wheel bolted to the flywheel. This, too, may have proved unsatisfactory, because of the oil thrown up, for the next Aveling illustration shows the forward mounted dynamo. The picture is from an official photograph of 1896 kindly lent to me by Mr. A. R. Dibben, whose help I have acknowledged on previous occasions.

Note that we now have a full-length canopy, though no twisted brass rods, and a belly-tank is fitted to the locomotive. The platform is strictly utilitarian in appearance, too!

Ransomes, Sims and Jefferies

My last picture shows a Ransomes' engine, and again is reproduced from *The Engineer*. This road locomotive was exhibited at the R.A.S. Show at Leicester in 1896, where the firm also exhibited a vertical high-speed engine "for electrical and other purposes."

The locomotive was mounted on "buffer springs" at the hind axle, and on a plate-spring on the front axle. It will be seen that the engine is single-cylindered, with side motion-covers, and it is stated that "the flywheel is also plated, so as to lessen the risk of frightening horses when travelling on the road." The plating is not shown on the engraving, however. Note that the dynamo is mounted on rails, with set-screws behind by which the tension of the driving-belt may be adjusted.

In describing this engine, *The Engineer* states that: ". . . the travelling showman has secured many advantages by adopting the useful road locomotive for hauling his merry-go-rounds and numerous vans from town to town. The same engine is employed for placing the apparatus in position at its destination, and for lighting up the show at night. The road locomotive hauls these goods . . . at a greater speed and at much less cost than if horses were employed. If the show vans are sent by rail, a number of horses must be hired for drawing them to the station, and for loading them on the trucks. By the possession of a traction-engine, as soon as the display is over the showman can betake himself to another district without delay.

"Moreover, it has been proved by actual practice that there is a clear saving of time by using the road engine for this purpose, in preference even to the railway, for the moderate distances that are usually required. When travelling by road, the showman can call at small towns out of the reach of the main line of railway."

Is it any wonder, then, that with all these advantages of road traction, the astute showman went in for it in a big way? And what a pity it is that so few of these magnificent engines are left today!

A NEW SOCIETY "BULLETIN"

We have received a copy of No. 1 of the *Bulletin of the British Light Steam Power Society*, the first to be published by the society itself. There is a very full account of the annual general meeting held in April, and we note some changes in the society's executive. The president is Lt. Col. A. G. Steele, while the former secretary, Mr. M. Harman Lewis, is now chairman. To fill the part of hon. secretary, Mr. T. F. Doyle has been elected; his address is: 39, Arundel Avenue, Chertsey Lane, Staines, Middlesex.

The bulletin is at present a six-page duplicated production, and in addition to the report just referred to, contains some technical information and announcements of interest to the members. We note a proposal to develop a small two-cylinder compound engine, 2½ in. and 4⅜ in. by 4½ in. stroke and fitted with piston valves. The first example of this engine has been made available to the members, through the generosity of one of their number. Drawings of this engine and of a suitable boiler are in process of becoming available.

There has also been made a useful single-cylinder donkey pump with a water capacity of 800-900 lb. per hour at 1,000 lb. pressure; a complete set of drawings, showing arrangement and all details of this pump is available together with the necessary castings for the cylinders.

Evidently the B.L.S.P.S. is forging ahead, and we await future developments with interest.

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

MODEL ELECTRIC LOCOS

DEAR SIR,—I have read with some interest the letter in your "Queries and Replies" column (issue dated May 14th, 1953) headed "Passenger-Hauling Electric Locomotive," and signed R.G.W. (Rye), and hope the following information will be helpful to the writer.

During the past winter, one of our members (Aylesford Paper Mills Sports Club, Model Engineering Section) Mr. C. E. Hooker, has successfully designed and constructed an electric locomotive in the 5 in. gauge. The exterior of the locomotive is on the design of the six-coupled L.M.S. diesel shunting engine of a type supplied by the Hunslet Engine Co. Its length over frames is 17 in. with a wheelbase of 8½ in.

The motor is a 12-volt car dynamo, with the field only, series wound to give 24 volts, up to 20 amps. The drive is through a worm and then chain and sprocket to a leading axle, giving a total reduction of approx. 8 to 1.

Current is taken from the a.c. supply of 230 volts through a transformer and rectifier to a third rail pick-up at 24 volts d.c. The locomotive can be remote controlled by reverse cams screwed to the sleepers at either end of the length of track, or by a lever protruding from the cab. If desirable, current could be supplied by two 12-volt car batteries (average 6 amp/hrs.) or by a petrol generator.

Mr. Hooker has put some considerable skill and ingenuity into this locomotive, and we are all rather amazed and pleased with the results.

On test the engine pulled three adults up a 1 in 10 gradient. With more trucks we are hoping to pull 10 to 15 children on level track.

If R.G.W. would care for further information we would willingly oblige, or better still if he would care to come to see the engine, we should be very pleased to welcome him.

For the information of interested readers, the track will be in operation, adjoining the model engineering tent, at our annual Cobdown Show, which will be held on the sports ground at Ditton, nr. Maidstone, on Saturday, August 29th.

Yours faithfully,
Maidstone. R. R. TURNER.

A MATTER OF COURTESY

DEAR SIR,—From time to time in your columns attention is drawn to the need when replying to advertisers or, in more general matters where the need to extend the courtesy is apparent, to enclose a stamped addressed envelope.

Model engineers as a body, are by no means lacking in these observances, although, no doubt the proverbial black sheep lurks within our fold, but he lurks too, amongst the ranks of private advertisers, as a recent experience of my own (not the first) has disclosed. A stamped addressed envelope accompanied my enquiry, but notwithstanding a subsequent reminder the advertiser has not seen fit to acknowledge the courtesy.

Yours faithfully,
Eastbourne. S. L. SHEPPARD.

IDENTIFYING LIGHT ALLOYS

DEAR SIR,—On page 751 of your issue of June 18th, a contributor, under the heading "Aluminium Casting" is, in fact, unduly stressing the dangers arising from mistaking magnesium for aluminium when melting over an open fire, since practically all magnesium melting is done over an open fire anyway, but to prevent undue oxidation, a cover of molten flux is used. Fluxes are used in a similar way, not only for protecting, but also for refining aluminium in the molten state. However, provided an acid base lining to the crucible or melting pot, as the case may be, is avoided, there is relatively no danger even in the absence of flux because, if the magnesium melt fires in a steel or graphite crucible (those are the two types strongly recommended), then it would burn without fuss or bother, but at the same time give off copious clouds of oxide, and the typical magnesium light. Provided the crucible is strong enough, and in the absence of magnesium foundry flux, let it burn. The addition to the surface of the melt when on fire of anything but the appropriate flux or specially prepared powder for quelling magnesium fires would, of course, be dangerous, but then those remarks apply equally to almost any molten metal.

A further important point to remember is to avoid sudden contact of molten magnesium with an extremely hot zone exceeding say 1,250 deg. C. since under those conditions magnesium is vaporised, and unless the vapour burns as formed, an explosive mixture can be formed in the atmosphere. Such high temperatures and heat reservoirs required for large scale vaporisation of magnesium would not be commonly met with in the average model engineer's workshop, however.

The easiest and most convenient way of selecting magnesium from a mixed bag of magnesium and aluminium is by means of an ordinary sharp penknife, by simply paring a small chip a few thou. of an inch thick. The feel is quite unmistakable; aluminium will drag and feel ductile, in roughly the same way as wrought-iron feels in relation to cast-iron, though again magnesium will, of course, possess a different feel to cast-iron, and the best way to gain experience is by getting pieces of each metal, and carry out the rough test as described above. After that I am quite sure your readers will experience no further difficulties in their selection of metal from a scrap-box.

Finally, provided certain precautions are taken, there is no reason why a model engineer should not melt and cast magnesium with the same ease that he at present enjoys with aluminium. Without doubt, magnesium is the easiest of the structural metals to machine, just to quote one of the many advantages which this metal possesses over other structural metals for certain applications, and the model engineer would profit very considerably were he to use it.

Yours faithfully,
For ESSEX AERO LTD.,
R. J. CROSS,
Gravesend. *Managing Director.*

L.B.S.C.'s Titfield Thunderbolt

IN $3\frac{1}{2}$ AND 5 INCH GAUGES

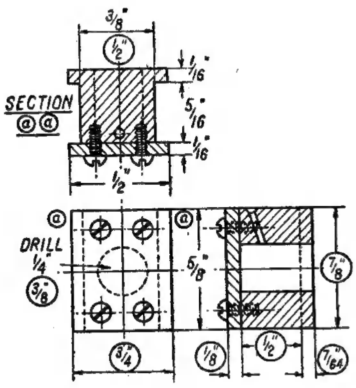
SOME beginner thought he had caught me out the other day by asking in a " superior " manner, how I proposed to poke a rod through the holes in the trailing axleboxes, to test for squareness, when the holes in the said boxes didn't go right through. Oh, these boys—bless his innocent heart and soul, all he has to do, is to use a piece of rod a little shorter than the distance over the outsides of the boxes when in place ; put a box on each end of it, and drop the lot in the horns, with the frame upside down. *Now* I'll bet his face is red ! However, you *can* have a thoroughfare hole, if you so desire, simply by making the front flange of the box detachable, as shown here. The axlebox, less thickness of front flange, is milled up and fitted in the usual manner, and the hole drilled right through. After fitting to horns, testing for squareness, and reaming to size, fit a detachable front plate made from sheet metal, attaching by four screws, $\frac{1}{16}$ in. or 3/32 in. as shown.

The leading and driving horns each have two stays. The upper one is made from a piece of steel or brass rod of rectangular section with the centre part milled or filed away as shown. Fix by two screws in each, running through the holes already in the hornplate, into tapped holes in the ends of the stay. The lower one is made from a bit of angle brass, also with the middle part filed away, to preserve the appearance of the bottom stay on the full-sized job. If the screws are put in from the inside as shown, there is more hold for the threads ; but they could be pushed through clearing holes, and nutted outside, if desired.

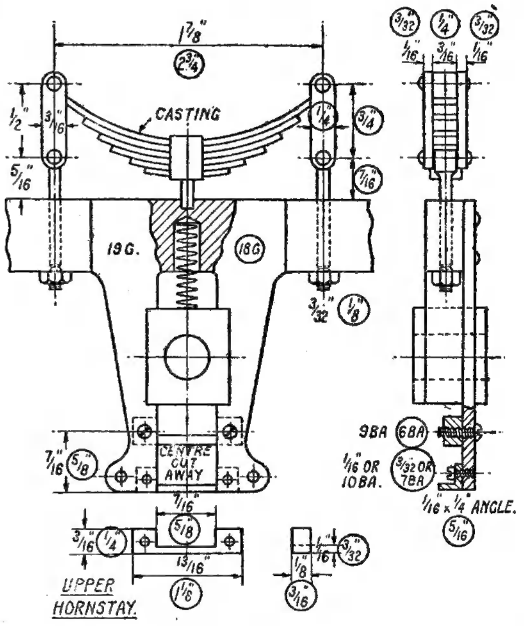
The trailing hornstays are merely bits of steel strip, attached by two screws as shown ; heads may be hexagon, or any old kind you may fancy. By the way, I've just noticed on checking the drawings, that I dimensioned the thickness of the trailing hornplates on the 5 in. gauge engine as 3/32 in. and the leading and driving as $\frac{1}{8}$ in. It doesn't matter a Continental if you make the lot to one or other of these dimensions ; just fit the boxes to the horns. They should be an easy fit sideways, so that the axles can follow any bad places in the line, by tilting the boxes a weeny bit ; but the boxes should not move fore-and-aft.

Springs

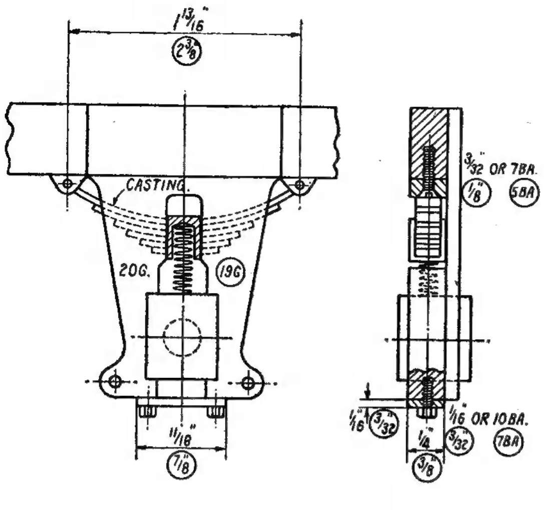
The springs are pretty conspicuous on not-so-big sister. As promised, I have given drawings of both cast dummy, and real working leaf springs. The leading and driving axleboxes have no connection at all with cast dummy springs, as the actual spiral springs are housed in the blind holes or pockets already drilled in the frames above the boxes. The exact length of spring required, cannot be obtained until the engine is finished, and carrying full weight ; but for a kick-off have the springs free and uncompressed when the axleboxes are right at the bottom of the slots. Cast leading and driving springs will only need cleaning up with a file, and a pip screwed into the bottom of the hoop

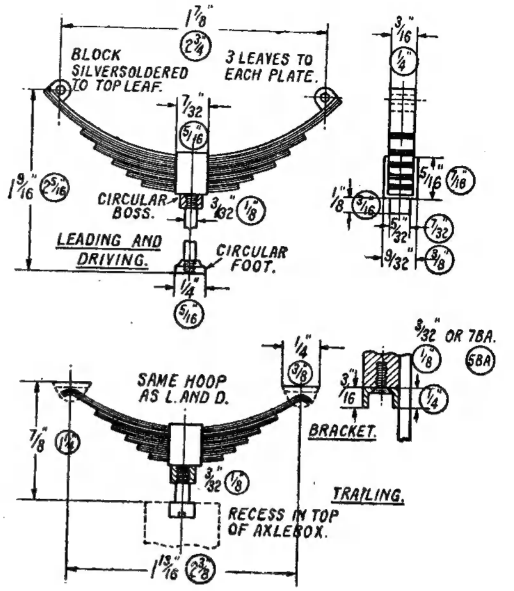


Alternative built-up trailing axlebox



Right—coupled axlebox and spring assembly





Trailing axlebox and spring assembly

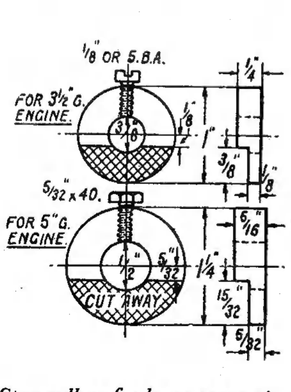
Right—Working leaf springs

or buckle, as shown. The suspension arrangement is similar to that on the full-sized engine; two links are made from steel strip, for each end of the spring, to dimensions shown. Note: to save time in describing, and get the engine on the road as soon as possible, I'm not repeating dimensions in this text, as builders can get them all from the illustrations, especially as two sizes are shown, for the two gauges. The pins are turned from square rod chucked truly in the four-jaw; measure the exact length of shank needed, from the actual job, allowing enough for the nut at bottom. After turning and screwing, part off far enough from the shoulder, to form a head, which can be rounded off with a file; then assemble as shown, using $\frac{1}{16}$-in. rivets for the $3\frac{1}{2}$-in. gauge engine, and 3/32-in. for the 5-in. job. Drill vertical holes through the frame members, at the same centres as the ends of the springs, and erect as shown.

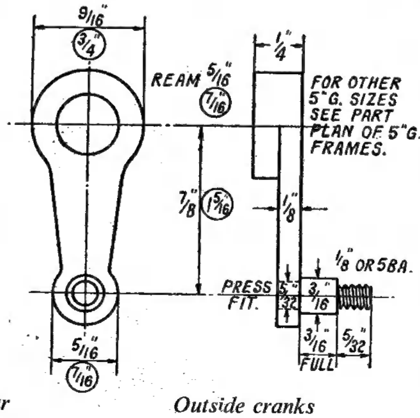
If working leaf springs are required—they are worth the trouble of making—build up the plates from pieces of thin spring steel, silver-soldering brass eyes to the top plates as shown. It doesn't matter about spoiling the temper of one lamination among so many! To make the hoop or buckle, chuck a piece of square rod of requisite size in the four-jaw, setting to run truly; turn boss, centre, drill and tap as shown, and part off to length. Cross-drill, and file the hole rectangular, to take the plates. The spindles are made from round mild- or silver-steel rod, screwed at both ends. The upper end is screwed far enough into the boss to clamp the plates securely. Incidentally, assembling the nest of plates, and fitting to the hoops, will most probably be the cause of a few extra terms being added to the dictionary of railroad Esperanto. I've had some! A little circular foot, or pad, turned up from round rod, drilled and tapped, is screwed on to the bottom end after the spring assembly has been erected. The suspension links and pins are exactly the same as described for the cast dummies, so no repetition is needed.

Cast trailing springs carry the working spiral springs in the hoops, so drill the latter as shown. The end brackets will be cast integral, so will only need attaching to underside of main frames by countersunk screws, as shown in the illustration. The spiral spring, fitted in the blind hole in the hoop, bears direct on the top of the axlebox, as shown; and the exact length is ascertained when the engine is complete, as mentioned above. The ends are squared off by touching them on a fast-running emery-wheel.

Working leaf springs are made up in the same way as described above for the leading and driving springs, but short screws are fitted in the bottom of the hoops, in place of the long spindles. The heads of these fit in recesses formed in the tops of the axleboxes, by drill and D-bit, to prevent the springs slipping out. The upper ends of the top plates are bent over as shown, and bear against



Stop collars for loose eccentric gear



Outside cranks

the undersides of the guide brackets. These are made from pieces of brass sheet, bent to a channel shape, filed to outline, and attached to the underside of the main frame by countersunk screws as shown. Commercial brass or steel channel may, of course, be used, if available.

Outside Cranks

It is possible that our approved advertisers will supply castings for the outside cranks, in which case they will only need cleaning up with a file, drilling, and fitting with crankpins. Otherwise, make them from mild-steel bar. They can be milled, or sawn and filed from the solid ; but an easier way is to shape the main part from steel of requisite thickness, and braze on the boss, in the same way that I have often described for making up bossed arms and levers for valve gears and similar jobs. Crankpins can be made from round silver-steel of size shown ; chuck in three-jaw for turning spigots and screwing ends. The pins should be a press fit in the cranks ; but for extra safety, slightly countersink the backs of the holes, leave spigots a shade over length when turning, and after pressing them in, rivet over the ends into the countersinks and file flush.

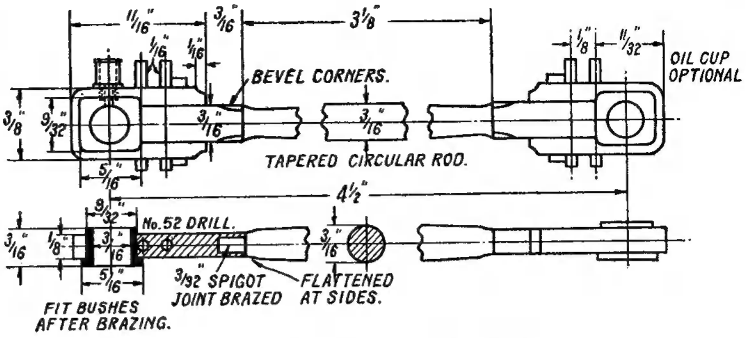
Don't forget to put the axleboxes on the journals before pressing the cranks on ; the cranks may be quartered with scribing-block and square, in the same way as I have often described, for quartering coupled wheels on an inside-framed engine. A detailed explanation of this job was given in the notes on *Tich*. Don't key the cranks yet ; wait until all the wheels are erected, and coupling-rods on, so that you can see that everything runs O.K.

Coupling-rods

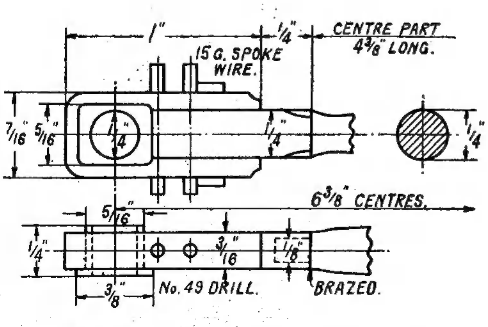
These are the real old-fashioned goods ! In days long passed, when most of the work was done by hand, the distance between centres of driving and coupled axles often varied on a batch of similar locomotives ; and the modern method of making the coupling-rods with plain bushed ends, would hardly have been applicable, as they would have had to be made specially for each engine. Adjustable brasses were therefore used ; but in the present instance we are doing a little bit of jerry-wangling, by using plain bushes camouflaged as square-faced adjustable brasses, fitted into end pieces which are replicas of those used on the full-sized engine. These ends are made from rectangular steel bar of the section shown in the illustrations, filed or milled to shape. Each end is all in one piece, from the extreme end, to the part where the centre section of the rod is attached. The two lines reaching from the centre section, to the bush, are just deep scratches, put in to please the friends and relations of our old nightmare Inspector Meticulous. The corners are slightly bevelled off as shown, which can be done either by filing, or by turning off with a roundnose tool, when the piece is chucked truly in the four-jaw, for drilling the hole for the spigot on the end of the centre part. The bushes may be turned either from rectangular bronze rod, of correct section to form the flange, or from round rod, large enough in diameter to allow of the flange being filed to the given size. Bushes should be a tight press fit in the holes drilled in the rod.

To save a lot of turning, the centre part of the rod, which is circular in section, can be made from round mild-steel of the diameter shown. The length of the rods between the end sections, is shown in the drawings ; but when cutting, don't forget to allow $\frac{3}{16}$ in. each end extra length, for the spigots. Chuck in three-jaw to turn these, then taper off the rod toward each end as shown. The easiest way to do the tapering, is to chuck the rod in three-jaw with nearly half of it projecting, and ease it with a fine file. Please don't start yelling out that this is " against the rules "—I know that well enough ; but it is easy, and it does the job fine, which is good enough for your humble servant. " Working to rule " isn't always the best way of doing the job, as any railwayman will tell you !

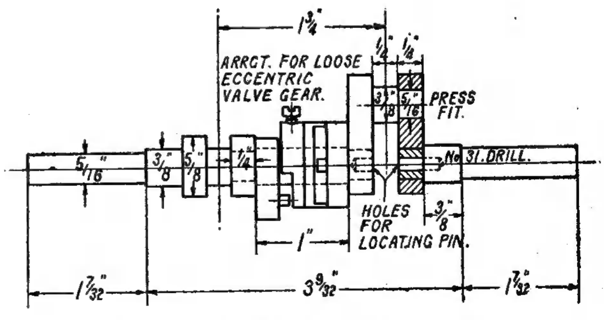
Press the ends on to the spigots, check for length between centres of bushes, and make certain that the end pieces are absolutely dead in line. Then braze the joints, using either brass wire, or Sifbronze. After cleaning up, flatten the ends of the



Coupling-rod—3½ in. gauge engine



Coupling-rod end—5 in. gauge engine



Crank-axle for 3½ in. gauge engine

centre part slightly with a file, at the sides, where it joins the end pieces ; this cuts off the sharp corners, and gives the finished rod the appearance of a one-piece job. See plan view.

The cotters are, of course, dummies ; but if they aren't put in, Inspector Meticulous will have about forty catsfits, so make them from bits of steel rod driven through holes drilled in the thickness of the end pieces. The rectangular cotter can be simulated by putting in two large-headed screws at top and bottom, and filing the heads to the shape of the ends of the cotter, before fitting the round ones. Talk about wangle ! Oil cups, if required, can be turned from brass rod and screwed in as shown ; they look pretty, but aren't of much use !

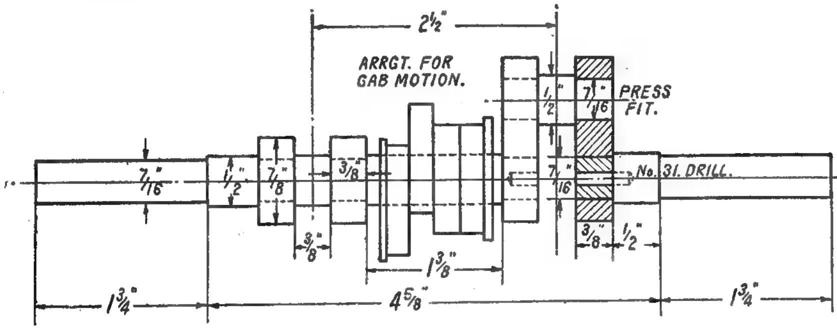
together whilst drilling. Take the sharp arris off the edge of each hole with a larger drill.

The centre part of each axle, the crankpins, and the end sections, are just plain turning jobs. Mild-steel of given size can be held in the three-jaw ; if the chuck is out, either correct with packing between offending jaw and the work (a slip of foil, or even paper, will usually do the trick) or else use the four-jaw and set the rod truly, by aid of an indicator. First turn the end pieces, complete with wheel seats and journals, and part off to overall length ; reverse in chuck and turn the spigots. Next, turn the centre part, and the crankpins. All spigots must be turned so that they just *won't* go in (says Pat). If you own a micrometer, first turn a trial spigot on an odd

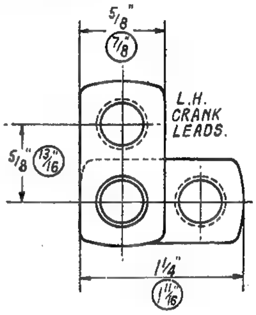
pop it, and chuck in four-jaw with the pop mark running truly. If you bring up the tailstock centre and set the pop mark to it, the job is easy. Open the pop mark with a centre-drill, drill a pilot hole, then open up and ream to correct size. The sheaves for the gab motion should be a tight push fit on the shaft.

Drill and tap holes in thickness, for setscrews, as shown. If you can get Allen screws, which are hardened, recessed for a key to tighten them, and cupped at the business end, I strongly recommend them. I used them on *Grosvenor's* eccentrics, and they hold like nobody's business. Otherwise, make grubscrews from silver-steel, slightly point the ends, and harden them.

Loose eccentrics are made similarly, but the holes should be reamed



Crank axle—5 in. gauge engine



End of both crank axles

Crank Axle Parts

The working parts of the engine being vital, I propose, with the kind approval of the K.B.P. to give separate drawings of the cylinders, motion, and other bits that matter, for the two sizes of the engine, instead of " dual measurements " on a single drawing. Then there won't be any misreading and consequent trouble ; at least, I sincerely hope not ! We'll kick off with the crank axles. One *description* will suffice, however, as it is only the dimensions that differ, the manufacturing job being the same in either size. Owing to the eccentrics being located on the axle between the crank webs, the whole issue cannot be brazed or welded up as a single unit, so I am specifying the press-fit method of construction that I used on my L.B. & S.C. Railway single-wheeler *Grosvenor*. First cut the crank webs from mild-steel bar of given section, allowing a little extra length, so that the ends may be turned to given radius when the crank axle is completed. Mark off and drill one, and use it as a jig to drill the rest, clamping the webs tightly

bit of steel, so that it *does* go in very tightly ; " mike " it up, and turn the crank axle spigots 0.001 in. larger. If you haven't a " mike," gauge the size by the divisions on the cross-slide collar ; turn the spigots to half-a-division bigger than the trial piece. Next, in the two ends of the centre piece, and in the spigot of each end piece, centre and drill a No. 31 hole about ½ in. in depth. These are for a locating pin, which will enable the shaft to be assembled " spot-on," the pin being cut out afterwards. Wait until the eccentrics are made, before starting to assemble.

Eccentrics and Stop Collars

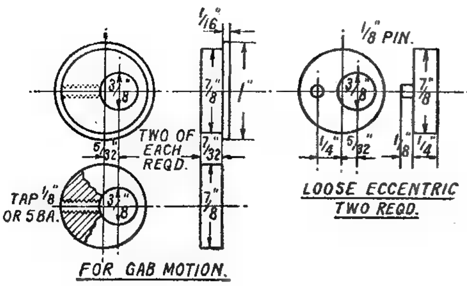
If the gab motion is to be fitted, four eccentrics will be needed ; two plain and two flanged—I nearly put two plain and two purl. The sheaves are just a kiddy's practice job in plain turning, from round steel rod held in the three-jaw ; but to avoid wobble, it is advisable to drill them in the chuck. The true centre will be left on each eccentric, by the facing tool ; mark off the eccentric centre from this, centre-

to a nice running fit on the axles. The stop pins are merely stubs of silver-steel rod pressed into drilled holes as shown. Note that the 3½-in. gauge loose eccentrics are plain, but the 5-in. gauge are flanged.

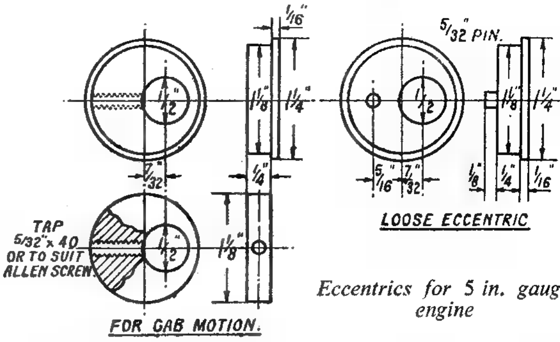
The stop collars are slices of brass or steel rod, of given sizes, drilled and reamed for axles in the same way as the gab eccentrics. Each has a segment milled, or sawn and filed out of it as shown, and is furnished with a setscrew in the thickness. This should not be slack ; use Allen screws if available, but if ordinary screws are used, the points should be hardened.

How to Assemble the Crank Axle

First press a web on to each end section. Now, if you heat the web, not red-hot, nor hot enough to scale it, but just medium, you'll find that the spigot which wouldn't enter the hole in the web, has changed its mind. Part reason why locomotives are all feminine. By using the bench vice to do the pressing, the spigot can be squeezed right home in the hole in the crank



Eccentrics for $3\frac{1}{2}$ in. gauge engine



Eccentrics for 5 in. gauge engine

web ; and when it cools off, far from being able to slack off of its own free will and accord, it would puzzle anybody to press or drive it out, without what the kiddies call "bustification" setting in.

Next, press one crankpin into each web, and then press one of them on to the centre piece. Put the eccentrics on, in the order shown in the illustrations, for either gab or loose eccentric valve gear, as desired. Then press the other web with the crankpin in it, on the other end of the centre piece, setting the webs at right angles by aid of a try-square. Now put a short piece of $\frac{1}{8}$-in. silver-steel in one of the holes in the centre part of the axle ; heat the web on one of the end pieces, bring the parts together with the silver-steel pin entering the hole in the spigot on the end piece, and the crankpin entering the hole in the web. Press home, and you'll find that the parts line up truly ; the locating-pin does the trick. Serve the other end likewise, then saw out the bits of pin between the webs, and file flush. Clean up, then turn the ends of the webs ; chuck one end of the shaft in three-jaw, and support the other end in a bush held in the tailstock chuck ; the ends of the webs can then be easily finished off with a roundnose tool.

The driving wheels can now be pressed on ; whilst doing this, put pieces of packing between the crank webs, or else the shaft will bend. Put on the axleboxes, then press on the outside cranks, setting them right opposite to the inside cranks, and erect the boxes in the horns, same as the leading axle. After fitting hornstays, put a bit of packing between each one, and the bottom of the axlebox, to keep the boxes at the running position whilst the cylinders and motion are erected. The coupling-rods can then be put on, and secured by nuts and washers. See that the wheels turn freely, with no binding of the rods ; if there should be a tight place, it will probably be due to the outside cranks being slightly out of angle. Adjust if necessary, and when O.K. the cranks can be keyed to the axles by little bits of silver-steel, pressed into holes drilled half in axle and half in crank boss. For $3\frac{1}{2}$-in. gauge engine, use 3/32-in. rod, and No. 43 drill ; for 5 in. use $\frac{1}{8}$-in. rod and No. 32 drill. Pins put through crossholes are likely to shear.

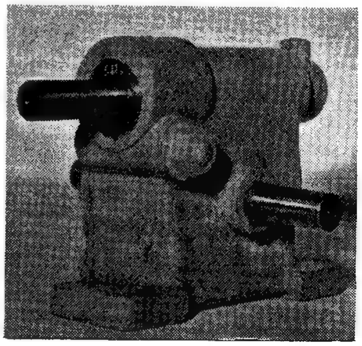
If the chassis is now set on the rails, and given a push, it should run freely, and the old cranks will emulate windmill sails, giving a sort of preview of what is coming later.

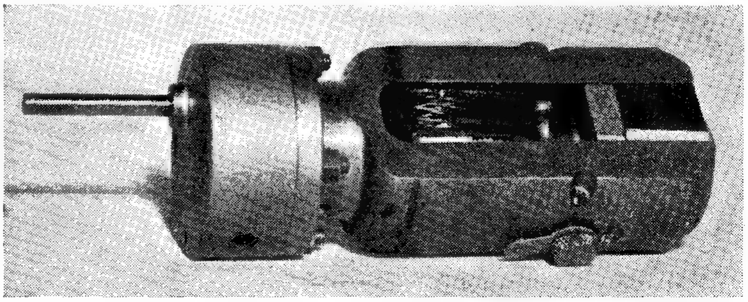
New Specialities at Bond's

ON a recent visit to Bond's o' Euston Road we noticed a number of new products which we consider to be of interest to many of our readers. These include a range of worm reduction gearboxes in various ratios, the largest being that illustrated, which has a reduction ratio of 30 to 1, and is capable of transmitting $\frac{1}{4}$ h.p. It has a cast-iron casing with oil bath lubrication; the two ends of the worm wheel shaft and one end of the worm shaft run direct in the casting, the remaining bearing being a bronze bush secured by a cotter bolt, with provision for end play adjustment.

The Bond's 12 V permanent-magnet motor illustrated was designed for industrial purposes, and can be obtained either with direct drive or with a 2 to 1 reduction spur gearbox, as shown. This is a very powerful and economical motor, for d.c. supply only, and reversible by simple switching, suitable for use as a heavy duty boat motor or other purposes.

Bond's also feature many interesting new lines in model steam fittings, including a range of correct pattern wheel valves, with cast wheels and plug cocks with spring-loaded self-adjusting plugs. Several further ideas are in course of development, and include totally new methods of constructing main frames and other components of large-scale locomotives.





NOTES ON LOCATING KEYS

By "Duplex"

THESE notes are concerned with anchoring keys to prevent endwise movement where it has not been found possible to fit the usual type of sunk key—a problem that is often encountered during the construction of small machine tools and other mechanisms.

One method of locating a key, encountered when carrying out repairs, is that illustrated in Fig. 1, which shows part of the secondary shaft in the gearbox of a 1902, 6 h.p., single-cylinder car made by a firm now long defunct.

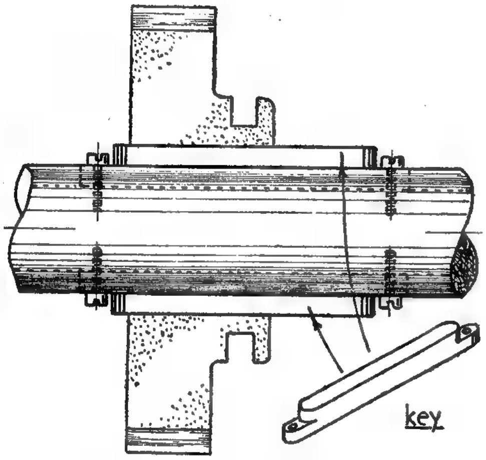


Fig. 1. Showing a method used for locating the keys in a gearbox shaft

As will be seen, the two long keys, on which the gear wheel slides, are fitted in open-ended keyways, and to prevent the key moving endways, it is secured to the shaft by a screw at either end. With even the slightest rock of the key in its seating, the screws will be stressed and eventually loosened ; it is little wonder, therefore, that the interior of this gearbox became all too familiar. Nowadays, of course, a splined shaft would be used in this situation.

In a cartridge-testing machine made in the workshop, a small shaft had to slide in a bearing block and be restrained from turning. As shown in Fig. 2, a keyway was milled in the shaft and a key was fitted to the bearing block. Although the key was pressed firmly into place, it was thought best to guard against the key shifting in any direction by providing a fixing at each end. For this purpose, both ends of the key were drilled and tapped and, with the key in place, the mouths of the holes were afterwards opened out with a countersink to enable the screw heads to take a bearing in the block itself.

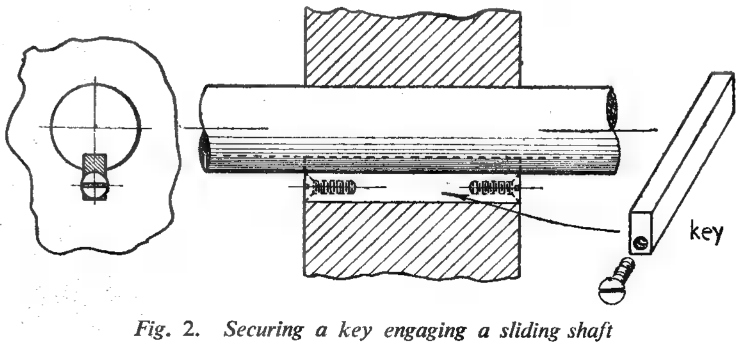


Fig. 2. Securing a key engaging a sliding shaft

Where the key is secured at one end only, as shown in Fig. 3, it can be located by means of a screw, but making this form of key from the solid entails a good deal of work. A neater job will be made, and the key will be more firmly seated, if the head of the key is fitted flush in a drilled recess. Apart from the usual workshop applications, fittings of this kind form part of the ejector mechanism of some best-quality shot guns.

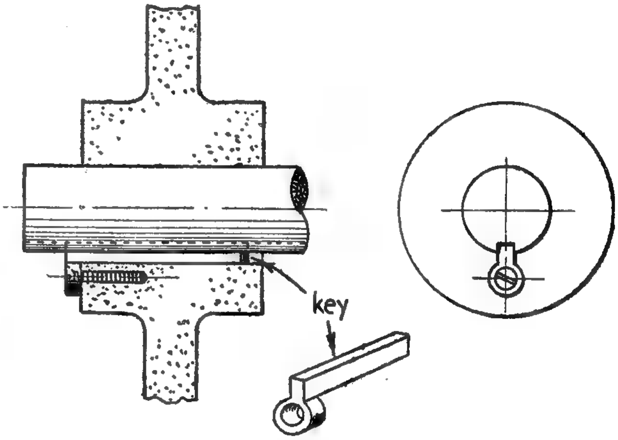


Fig. 3. End-locating a pulley key

A convenient way of fitting a key to a pulley or other component sliding on a shaft is illustrated in Fig. 4. Here, the key is made a press-fit in the pulley keyway, and the two upset ends prevent endways movement.

The method illustrated in Fig. 5 can be used for pressing the key firmly into place. Two lengths of brass rod serve as levers, and the mechanical advantage gained enables considerable pressure to be evenly exerted on the two ends of the key.

The key can be easily removed by lightly hammering on a piece of brass rod, held against the projecting ends of the key so as to drive it inwards.

The drilling machine spindle, shown in part in Fig. 6, is formed with a single axial keyway, and the drive from the bevel pinion is taken by a key which allows the shaft to slide freely.

The lower surface of the pinion, and with it the head of the key,

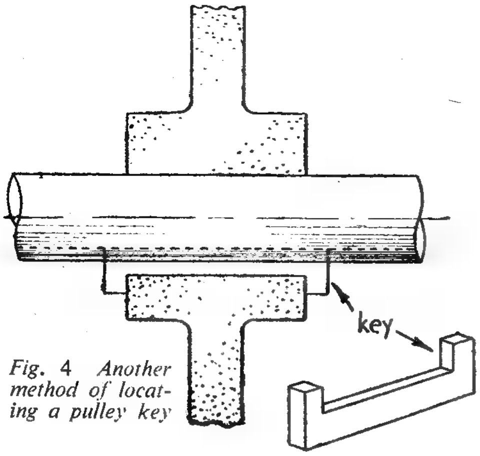


Fig. 4 Another method of locating a pulley key

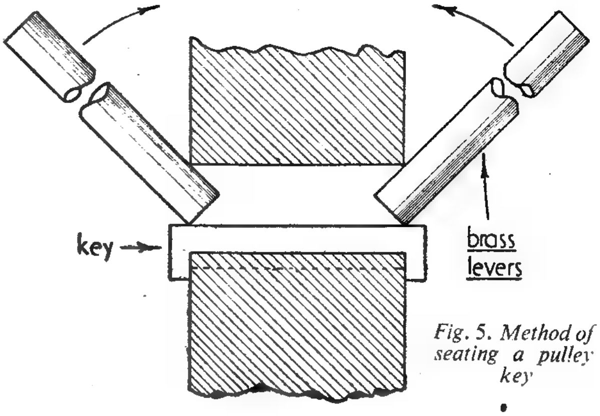


Fig. 5. Method of seating a pulley key

is in contact with the upper bearing housing of the machine, and the pinion is kept from rising as it meshes with its fellow gear wheel. The key must, therefore, be fitted in a way that will keep it from being carried upwards with the movement of the spindle.

To provide against this displacement, the key is shaped with a projecting head, fitting into a recess end-milled in the lower surface of the pinion.

The method of securing a key, shown in Fig. 7, was used when fixing the heavy flywheel of a petrol engine to the projecting end of the crankshaft. The engine in question was made for driving the machine tools in the workshop and was built up from a variety of engine parts, including the flywheel removed from a four-cylinder Meadows engine. The crankshaft of the engine had a tapered seating for the flywheel, and the fixing was by means of the usual key and clamping nuts.

In order to secure the flywheel to the parallel crankshaft of the workshop engine, a tapered, split collet was machined and this was drawn into the flywheel taper by means of a ring-nut, thereby closing the collet on the shaft. In adddition, as shown in the drawing, a key was fitted in a keyway machined in the collet to engage the crankshaft keyway and, to provide for end-location, the key was held in place with two screws.

To afford further security, two steel pegs were screwed into the collet, and their sides were carefully filed flat until a good fit was obtained in the flywheel keyway.

When the job was finished, the flywheel ran quite truly and it has remained accurately mounted in spite of much hard running extending over a period of more than ten years. As this method of attachment proved to be satisfactory, it was afterwards used for mounting flywheels and pulleys on several air compressors, as well as for other power drives with intermittent loading.

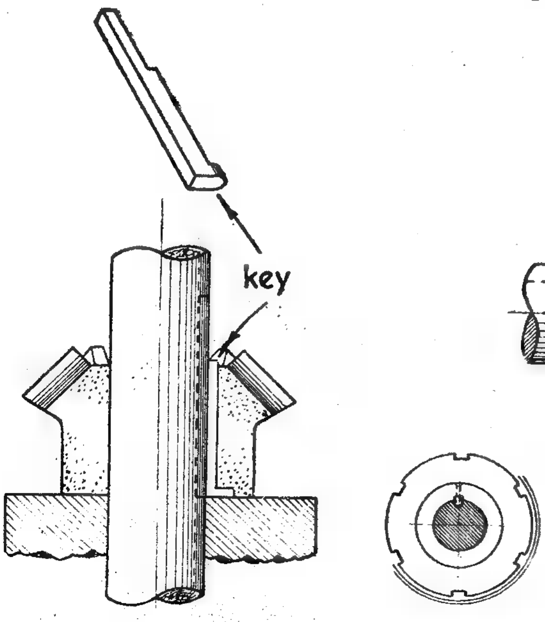


Fig. 6. Keying a bevel pinion to a drilling machine spindle

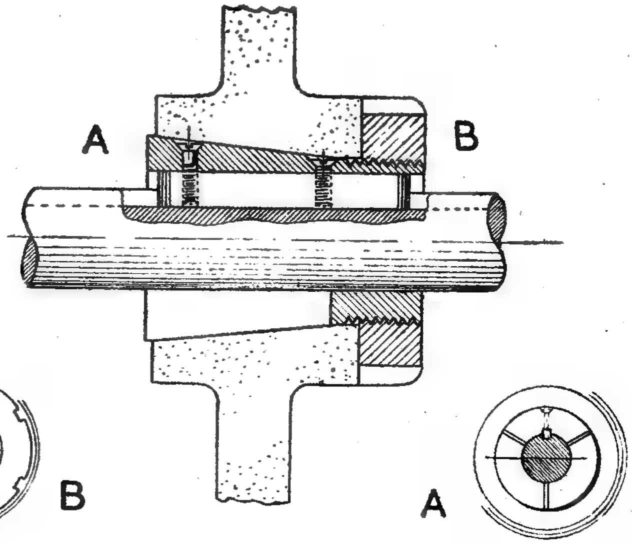


Fig. 7. Fixing a key in a flywheel collet mounting

FLASH STEAMERS

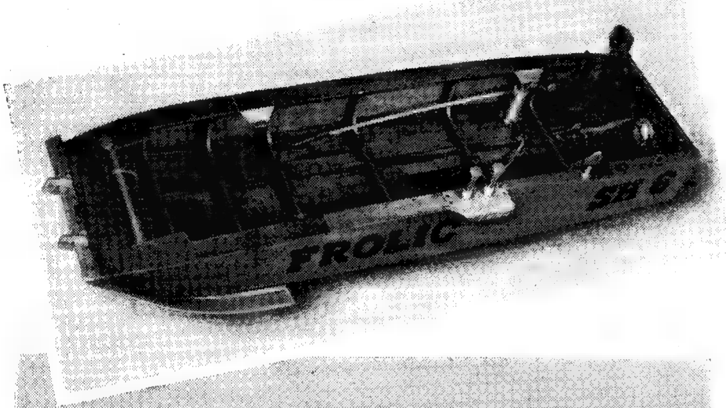
A CHRONICLE OF EXPERIMENTS, TRIALS AND TRIBULATIONS

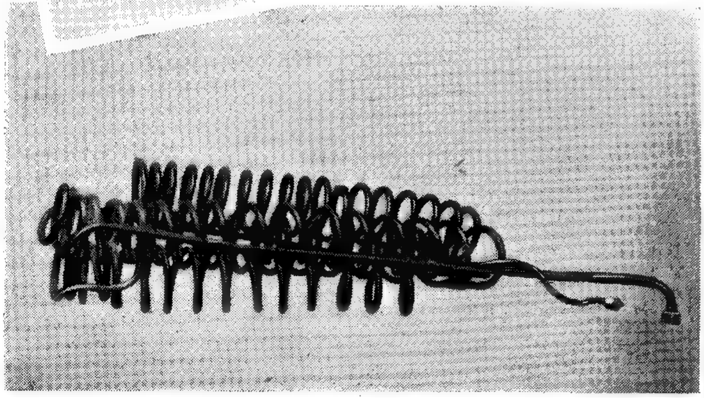
MY interest in model power boats dates back to about 1936 during which time I have made four " A " Class steamers, and at the moment, have a new hull under construction. It has been suggested to me that a description of the development of these boats would be of interest to readers, and I was particularly instructed not to omit the early experiments. To one more accustomed to running boats than writing about them, this is not an easy task, and up to the time of writing this, I have spent some time in trying to set down a coherent and readable account in chronological order. The constant changing from one branch of the subject to another which this entails makes it difficult to follow the development of any particular part of the plant, and I therefore propose to commence the description of these boats with a list of their salient features, and then to take each point in turn, and give the reasons for the changes made, with any comments on them which I think may be of interest.

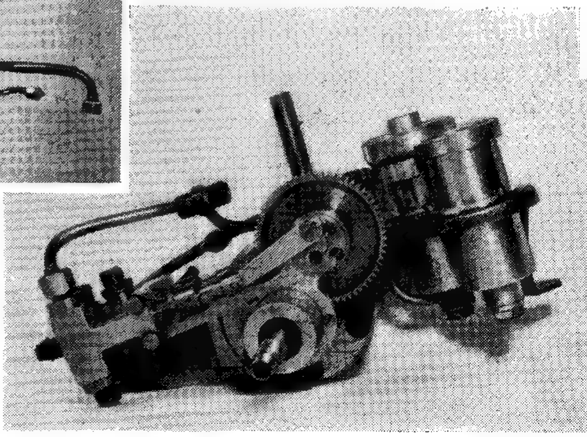
Although I have carried out a considerable amount of work on flash steam development, I do not claim to have exploited more than the bare fringe of the possibilities, and the efficiency of the various items could no doubt be raised considerably were enough time available. I have done little bench testing, although I hope to find some time for than in the future, and in many cases conclusions are based on deduction (which may be quite wrong), rather than on sound data. It seems a pity that the flash steamer appears to be in danger of slow extinction, and I should be pleased to give any further information I have to interested people who think, like myself, that this branch of model power boating is worth more attention than it has been given in recent years.

Hull Features

The first hull was of tin plate, all others of plywood. Reason for choice of tinplate—non-inflammable. Advantages of plywood—great rigidity, weight for weight, greater vibration-damping properties.





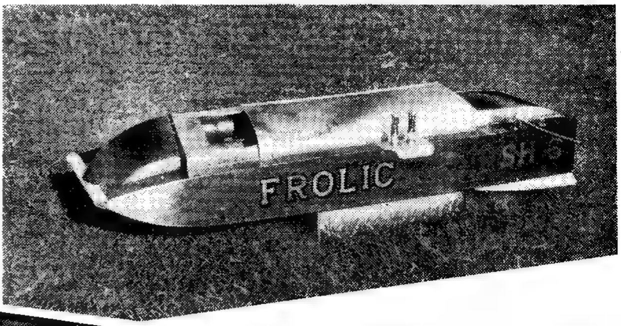


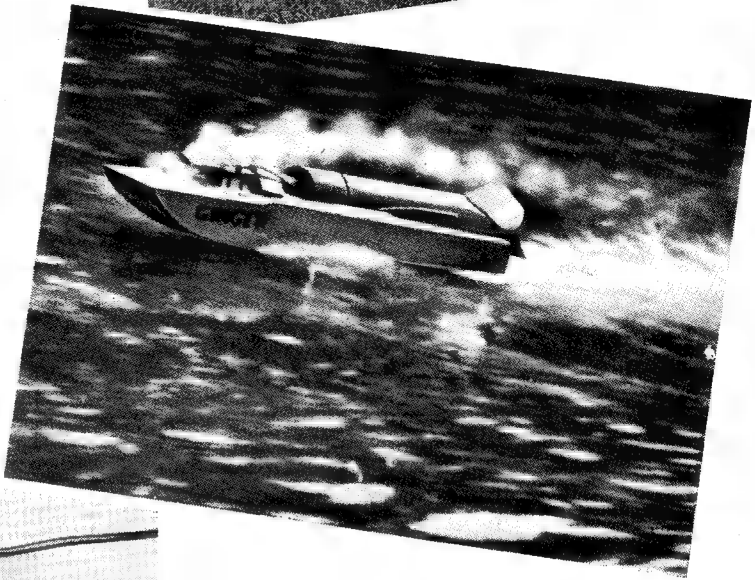
Above—The hull of " Frolic "

Below—Boiler coil for the above

Right—The horizontal engine, with pumps and oil tanks

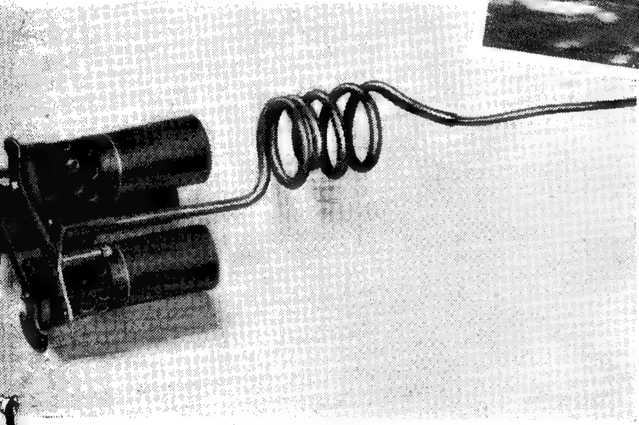
By B. J. Pilliner





Construction of Wooden Hulls. Skin and frames of birch ply, resin-bonded. Engine bearers, ash. Stringers, any suitable straight-grained semi-hard wood. Skin attached with brass pins and glue. Trust is put in the glue, the pins in general being regarded only as a means of holding the joint in contact, and not relied upon for strength. Finish, copal varnish.

Glue. Change from Casein to Durofix. Reason—Casein loses a large proportion of its strength when wet. There is some risk of getting water in joints when a hull has had considerable use. Durofix—The main criticism of this type of glue is that it sets so rapidly that it is very difficult to pin on large sections of the skin before the glue is too hard.



Above—"Frolic" as first launched

Below—"Ginger" running at a brisk speed

Left—"Frolic's" blowlamp burner

Change to Resorcinol Formaldehyde Resin Glue. Type used—Leicester Lovell's. A liquid used with a powder hardener, mixed before applying. Pot life $3\frac{3}{4}$ hr. With both surfaces of joint well coated, it was found that up to half an hour can be spent in pinning up.

Advantages. Heat resisting properties equal to or better than wood. Oil and petrol proof. Good strength, which is not deteriorated by repeated changing of conditions—moisture and heat. Very good gap filling properties; it can be mixed with a filler, if necessary, for this purpose, and has a very small change of volume on curing. In this respect, I believe it is better than other synthetic resins. I have no criticism of this glue and no shares in the above mentioned company.

Weight of Hulls

Considerable care was taken with *Ginger* to obtain the low weight of 2 lb. 2 oz. The increase on the two later hulls is due to greater rigidity to cope with increased power. *Ginger* and *Frolic* are framed chine hulls, following in general the constructional methods of Mr. Westbury's 24 in. hydroplane described in THE MODEL ENGINEER some years ago. Weights of surface planing hulls are given less skids.

Type of Hulls

Hulls up to and including *Frolic* are generally similar, being regarded as a rectangular-section container for the plant, suitably shaped at the nose. Little or no regard was paid to airflow, as regards the hull itself, although an unsuccessful attempt was made to enclose the plant of *Ginger*, and that of *Frolic* was totally enclosed. These hulls all had vertical transoms, a point which has been altered in the new hull under construction. This new hull also has a rounded section and decreased frontal area.

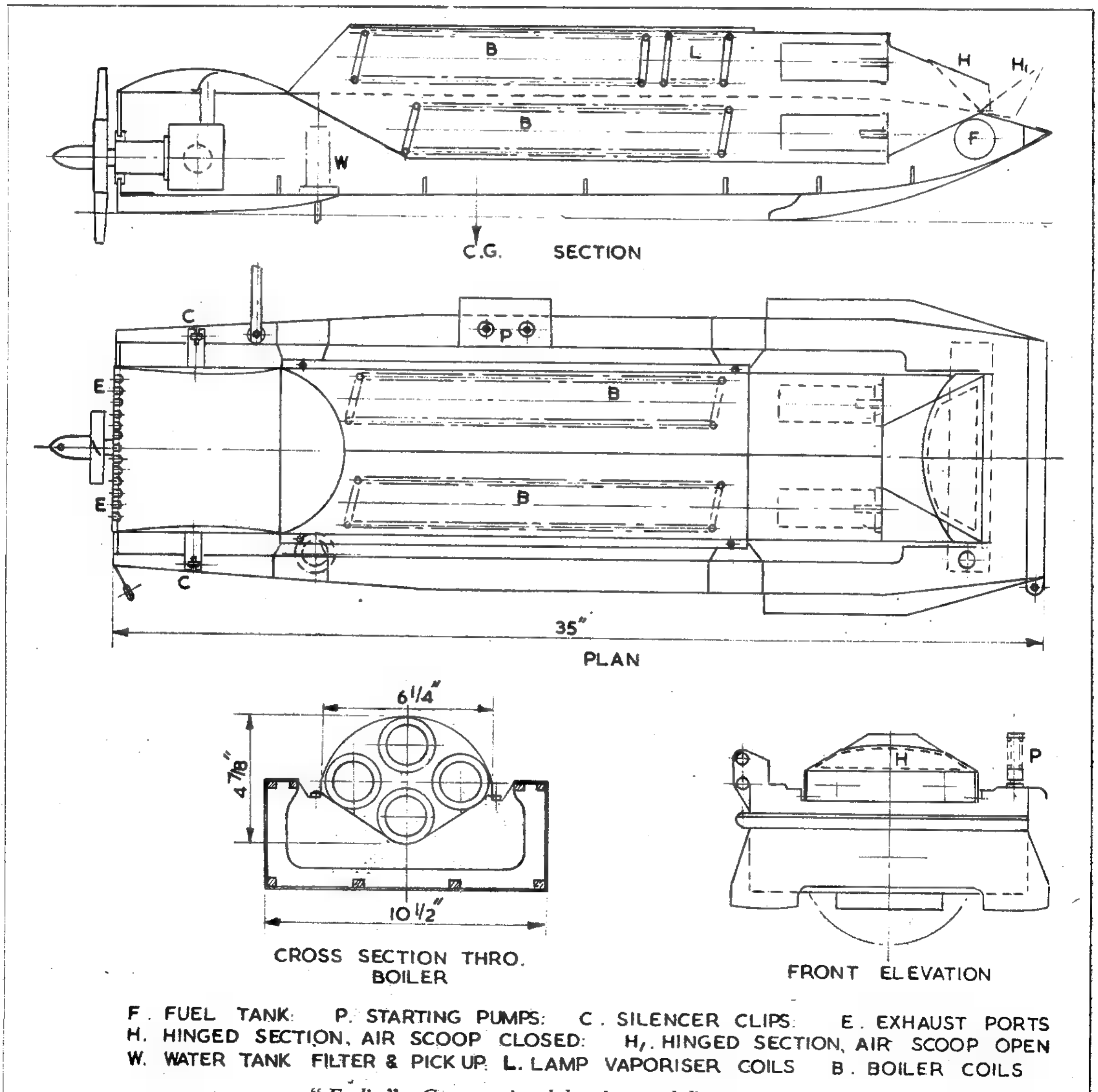
Change in skid position on "Frolic." This change to a rear skid immediately in front of the propeller controlled the maximum depth of water on the propeller and considerably reduced a tendency which the boat had to kick up at the stern. It also helped

in starting, as the propeller has a very strong lift, and with the first system, most of the weight was taken off the two rear skids allowing engine torque to heel the boat badly.

Blowlamp

Change from twin jet to four jet. Reason for change.—Expectation of transferring more heat to the boiler, as the first few boiler coils in front of the burner are more effective than the remainder. The complication of separate vaporising coils for four burners, on or in the flame tubes, was avoided by using a common vaporiser forward of the top flame tube, in the position normally occupied by the first boiler coils. The four-jet lamp is approximately the weight of its predecessor owing to a saving in weight on the vaporiser which has the hottest part of the flame passing through it. A consequence of this change is increased temperature of the flame tubes, which cannot now transfer heat to the vaporiser. The sheet steel flame tubes of *Ginger* warped very badly, and a change was made to 0.015 in. stainless on *Frolic*, which is quite satisfactory. A characteristic of the four-jet lamp, due to the vaporiser position, is bad surging when used with pressure container. This is unimportant, as a change was made at the same time to pump feed, the lamp taking the whole output of the pump (no bypass or relief valve), under which conditions, surging is apparently impossible.

Change from pressure to pump feed. Reasons for change.—Smaller fuel tank, which can be filled completely, and is at atmospheric pressure. Simplification of knock-off switch, which now operates to release

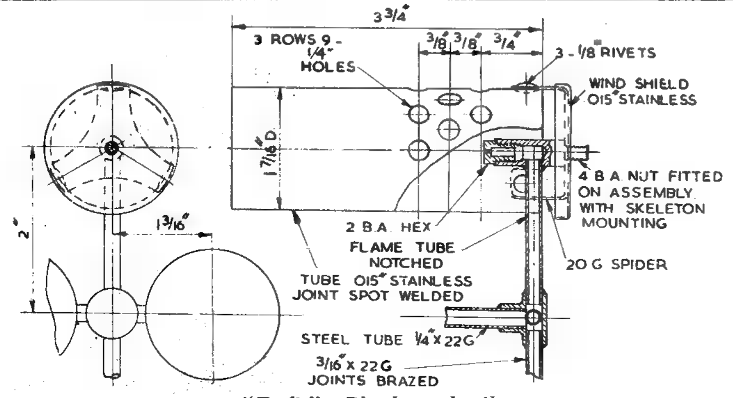


"*Frolic*"—*Constructional drawings and dimensions*

BOAT	HULL	BLOWLAMP	BOILER	ENGINE	PROPELLER	SPEED 500 YARDS
1. YEAR 1938. 16 LB.	TINPLATE SINGLE STEP 39″ LENGTH x 13″ MAX. BEAM WEIGHT 3 LB.	PRESSURE TANK. 80 LB. P.S.I. TWIN JET. JET DIA. .043″	33′ ⅜″ DIA. x 21 G. TUBING. 2 LONGITUDINAL COILS. 2 CROSS COILS.	TWIN 1 1/16″ BORE x 1″ STROKE. POPPET VALVE INLET (LIFT) .06). UNIFLOW EXHAUST. ENGINE FORWARD.	2⅞″ DIA. x 5″ PITCH. SUBMERGED	APPROX. 18 M.P.H.
2. *FRISKY* YEAR 1939-1946. 16 lb.	1/16″ PLYWOOD ON STRINGERS AND STIFFENERS. CASEIN GLUE. SINGLE STEP. 39″ LENGTH x 12″ MAX. BEAM. WEIGHT 4 LB.	AS ABOVE.	40′ ¼″ DIA. x 21 G. TUBING. 2 LONGITUDINAL COILS. 2 CROSS COILS.	SINGLE 1 1/16″ BORE x 1″ STROKE. POPPET VALVE INLET. (LIFT 04″) CHANGED TO SINGLE 1″ BORE x 1″ STROKE. PISTON VALVE. ENGINE FORWARD.	3½″ DIA. x 7″ PITCH. SUBMERGED	39 M.P.H.
3 *GINGER* YEAR. 1947-1950. 16 LB.	1/16″ PLY ON STRINGERS AND FRAMES. "DUROFIX" GLUE. SINGLE STEP CONVERTED TO SURFACE PLANING — 2 SKIDS FORWARD, 1 SKID AFT. 35″ LENGTH x 10½″ MAX. BEAM WEIGHT 2 LB. 2 OZ.	ATMOSPHERIC PRESSURE TANK-PUMP FEED. 4 JET. JET DIA. .032″	60′ ¼″ DIA. x 21 G. TUBING. (REDUCED TO 42′) 4 LONGITUDINAL COILS. 1 SHAPED COIL.	AS ABOVE. ENGINE FORWARD.	3½″ DIA. x 7″ PITCH. SUBMERGED CHANGED TO 4″ DIA. x 8½″ PITCH. SURFACE PLANING.	41.06 M.P.H. M.P.H. (MAX. LAP SPEED 44) 49.9 M.P.H. (MAX. LAP SPEED 53)
4. *FROLIC* YEAR 1951-1952. 16 LB.	1/16″ PLY ON STRINGERS AND FRAMES. RESORCINOL RESIN GLUE. 1 SKID FORWARD, 2 SKIDS AFT. CHANGED TO 1 SKID AFT. 2 SKIDS FORWARD. 35″ LENGTH x 10½″ MAX. BEAM. WEIGHT 3 LB.	AS ABOVE.	33′ ¼″ DIA. x 21 G. TUBING. 4 LONGITUDINAL COILS.	AS ABOVE. ENGINE AFT.	6¾″ DIA. x 10¼″ PITCH. SURFACE PLANING.	58 M.P.H. (MAX. LAP APPROX. 70)
5. UNDER CONSTRUCTION 16 LB.	1/16″ PLY ON STRINGERS AND FRAMES. RESORCINOL RESIN GLUE. 42″ LENGTH x 10½″ MAX. BEAM. WEIGHT 3 LB.	AS ABOVE	AS ABOVE	AS ABOVE ENGINE AFT	SURFACE PLANING	

boiler pressure only. Improved safety to hull from burning, as lamp goes out in the event of engine failure. Before this change, many boots full of water had been collected when, after an unplanned stop, the boat was on the other side of the pond with the lamp full on and the hull starting to burn. It was also thought to be an advantage that, assuming the engine speed maintained on a run, the fuel feed was also unchanged. (There is an inevitable fall of pressure, and consequently rate of feed, with the pressure container unless some mechanical or other means of maintaining pressure is provided.)

It is logical to feed water and fuel in definite proportions, which is the case when mechanical pumps are used for both. Assuming, then, that the feeds are correctly proportioned, the amount of heat in the boiler is not lowered, and a constant speed can be maintained throughout the run. This is useful when trying to assess the value or otherwise of changes made to the plant, although a somewhat greater speed over a particular distance can be obtained by feeding more water and starting with a rather hot boiler. Under these conditions, more heat is being taken from the boiler than is being given to it, and it is inevitable that the steam will go wet after some laps, with a considerable drop in speed.



"Frolic"—Blowlamp details

Blowlamp details—"*Frolic*." This lamp has been run on various grades of fuel, from blowlamp fuel, supplied by High Flash Fuels, of Croydon, which is more volatile than petrol, to neat paraffin, with the vaporising coil unchanged. It is possible that there is too much vaporiser for the blowlamp fuel, although this fuel is very clean and has very little tendency to carbon the jets. At the other extreme, paraffin is rather sooty and difficult to warm up.

The drawing shows the annular space, obstructed only by the three-arm mounting spider, and the three rows of holes, by which air is admitted to the flame tubes. Some variation of the air admitted is necessary when changing fuel, the maximum being required for paraffin.

(To be continued)

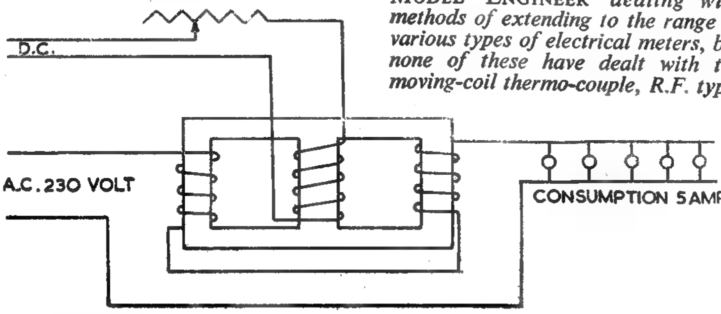
QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Design for Choke Coil

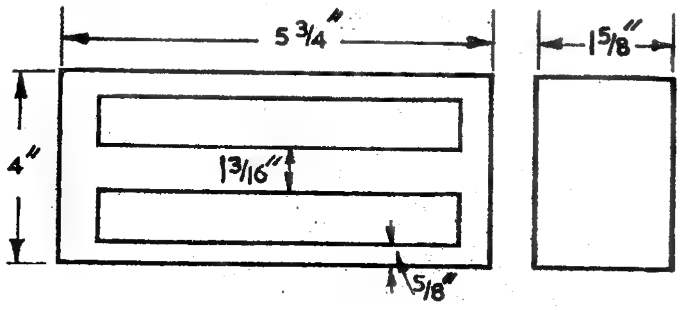
I wish to make a choke coil for the purpose of dimming a number of lights by saturation effect. I have some laminated cores with the dimensions shown in the sketch. Is it possible to make use of these, and if not, could you tell me what size I would require and where they could



be obtained? Could you also give me the number of turns and size of wire I would require on each coil? I would like to run the d.c. coil from 12 volt supply if possible.

M.K. (Littleborough).

The shape of your core is unsuitable for the purpose you have in mind, namely regulation by saturation. To enable the method to be carried out, coils of a much shorter core length should be used. This would mean a special design of choke. A winding for the amount of iron you show could be a total of 180 turns of 17-s.w.g. plain enamel-covered copper wire, arranging the core as an ordinary choke with movable core. Stampings of any kind are difficult to obtain at the present time; the only likely source is the surplus market.



Recalibrating Electric Meters

I have seen several articles in THE MODEL ENGINEER *dealing with methods of extending to the range of various types of electrical meters, but none of these have dealt with the moving-coil thermo-couple, R.F. type. I have tried to convert meters of this type, but apparently the usual method of using a shunt or a resistance to change the range of the meter does not work out in direct proportion in this type of meter. As I have no means of checking the results accurately, I should be glad to know what methods should be used in calibrating meters which have been adapted to work on different ranges of voltage and current.*

B.T.H. (Scotforth).

A complication is likely to arise when using either resistance or shunts in connection with meters, as the resistance of the couple itself is not constant, but increases as the temperature rises. Therefore, the calibration of the meter with an external shunt or resistance would not be constant. Generally speaking when meters of this type are adapted to serve as volt meters or ammeters, the thermo couple is removed and meter movement connected in the normal way to the resistance or the shunt, as the case may be. In any case, where meters are adapted to deal with various ranges of measurement, the calibration must be carried out very carefully, using either a test meter of known accuracy, or a sensitive resistance bridge, in connection with a accurately calibrated test resistance.

Battery charging

I am using small accumulators of the nickel-iron type for ignition in a model boat and find difficulty in getting them properly charged. Is it practicable to use primary batteries, such as the Leclanche type, for charging accumulators, as I have no mains supply available to work a trickle charger? What voltage battery should I need, and what rate of current is necessary for charging?

G.E. (Norwich).

Any source of direct-current supply may be used to charge accumulators, so long as the voltage available is greater than that of the cell or cells to be charged; but whether it is an economical proposition to do so in the manner you suggest, is another matter. Primary batteries have often been used in the past, the Fuller type of cell being recommended for this purpose, but Leclanche cells are not suited to heavy discharge for long periods, and might be found unsatisfactory. One primary cell producing $1\frac{1}{2}$ volts would be capable of charging one cell of a nickel-iron accumulator, and an advantage of this method is that it provides automatic control, the current being greatest at the start, when the accumulator voltage is low, and tapering off at the end of the charge when the voltages tend to become equalised. Except where a slow charge is required, it is not necessary to use a resistance to control the charge rate. In all charging circuits, the positive supply lead should be connected to the positive terminal of the battery. Primary batteries are expensive to run, when any considerable electrical output is called for, as the source of energy, or "fuel," is zinc or a similar metal, in addition to the cost of chemicals and other items necessary to release the energy.

AN ELECTROMAGNETIC CLUTCH

By R. F. Stock

THE majority of radio-controlled ship models can perhaps be divided into two categories—those designed to exploit the possibilities of a very comprehensive control system, and those models built primarily for a high performance. The latter class generally uses the internal combustion engine as a source of power, and this type of power unit, though admirable in most respects, suffers greatly from its inflexibility; the result is that the faster R/C models, though requiring (and generally fitted with) an accurate proportional rudder control, are often seen with no means whatsoever of controlling their forward progress. Stopping such a model involves some awkward antics on the part of the operator, unless the drastic and decidedly final step of incorporating a radio-controlled cut-out is adopted.

The speed of most petrol engines can be remotely controlled by varying ignition timing, while the addition of a centrifugal clutch may, with luck, be capable of giving a " stop " position. This, however, is of no use to the owners of c.i. and glowplug engines; what is required is some form of simple and reliable clutch.

Automobile or marine type clutches could probably be scaled down for the larger installations, but they would be very tricky to operate (and keep in adjustment) for the smallest engines; furthermore, if instantaneous engagement is required, as is most desirable, the weight penalty of a suitable solenoid and batteries for operation would be disproportionately high.

Since the operation of any clutch for R/C must be initiated electrically, the obvious type of clutch is the electromagnetic variety which requires no moving parts to engage it.

A continuous energising current is, of course, necessary the whole time the clutch is engaged; the suitability of this kind of clutch for our purpose —and particularly its installation in small models—depends almost entirely on whether the electrical consumption for a given torque transfer is acceptable. A few preliminary calculations indicated that this would be so and an experimental clutch was designed, constructed and tested. It is this model which forms the subject of the present article.

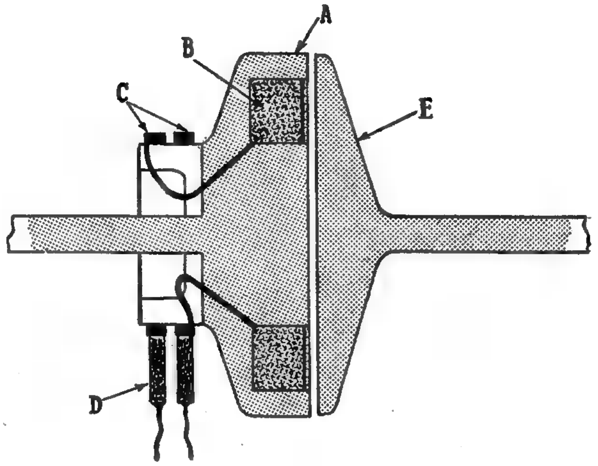


Fig. 1. Principle of simple magnetic clutch.

Principle

Anyone who has had experience of magnetic chucks and similar equipment will know that relatively small magnets can produce an enormous force; this desirable property is dependent upon the use of an efficient magnetic circuit with air gaps eliminated (or at least reduced to a minimum). The multi-plate type of clutch would be theoretically ideal for incorporation in a magnetic circuit, but on a small scale it would be difficult to produce in practice, and would tend to cancel out the virtue of simplicity which is essential for small units.

A simpler layout was, therefore, thought best, provided it could give an acceptable efficiency, and the general idea—which could hardly be simpler—is illustrated in principle in Fig. 1.

A, the driving member, is an electromagnet of the cup or " pot " type and is mounted directly upon the input shaft (which may well be the engine crankshaft); in an annular recess is the coil **B** with lead-out wires connected to slip-rings **C.** When the latter are connected via brushes **D** to a source of E.M.F. the coil is energised and opposite magnetic poles are produced at the rim and the hub of the driving member.

E is the driven part, mounted on a shaft concentric with the input shaft. It forms the armature for **A,** and completes the magnetic circuit.

A very powerful axial force is produced, tending to hold the two parts together; the friction existing at the polar faces, due to this force, is the medium via which torque is transferred.

When the energising current is cut off, the axial pull is largely removed; with any practical magnetic material some force is bound to remain, but this can be disposed of as described later, thus permitting the clutch to move " out of engagement."

It will be seen that the mechanism is very simple, and also that the mechanical efficiency is poor, since the friction faces must be both smooth and of ferrous material. This disadvantage is greatly outweighed, however, by the high magnetic efficiency of the clutch; the latter is by far the most important factor, and any attempt to incorporate friction material at the polar faces is doomed to failure.

Design

The clutch was designed for one specific application, a petrol engine of 6 c.c. This developed its power at a relatively low r.p.m. and it is probable that most engines between 5 and 10 c.c. could be accommodated by the same size of clutch, the actual torque being the important factor rather than horsepower. It was quickly realised that the unit would be similar in form to the flywheel, and in cases where weight was vital it could replace the normal flywheel with beneficial results to displacement. For this reason it was decided to limit the overall diameter to 2½ in. to enable the clutch to be used in existing

and conventional installations.

A survey of the material position produced no suitable bar as large as this, and a piece was selected which would clean up to just over $2\frac{1}{4}$ in. This somewhat arbitrary factor decided the overall diameter.

A given weight of iron is most efficiently disposed in any closed magnetic circuit (with no air-gaps), when the cross sectional area is constant throughout. This principle was largely adopted in the present case, but the outer pole was increased in area relative to the inner pole, since it plays the more important part. The space left for the coil was decided by guesstimation (which can be checked as design proceeds). A central bore of $\frac{3}{8}$ in. was left at the polar face, to accommodate a shaft and spring as described later.

The rear face of the armature was made conical in order to preserve a constant cross section to the magnetic path; a similar reason requires a conical face to the back of the driving member, and it was convenient to make this cone one half of a vee groove pulley for engine starting purposes. Where this is not required, the back of the clutch could end as indicated by the pecked line, with the slip-ring carrier bolted directly to it (see Fig. 2).

The above considerations, together with such details as the radiusing of corners—always desirable in a magnetic circuit—eventually crystallised into the design shown in Fig. 2.

The $\frac{1}{4}$ in. bore in the driving member and the $\frac{1}{4}$-in. bore bronze bush pressed into the driven part are intended to suit this one particular application. Other types of fixing to suit various installations would be quite in order and would have a negligible effect on the performance of the clutch.

Tests indicated that the engine concerned produced a maximum torque of under 4 lb./in. and the above figure was used as a specification.

Fig. 2 shows that the effective diameters of the inner and outer poles are in the ratio of approximately 1 : 3. Both poles must exhibit the same axial thrust, so that the power transferred by each must be in the same ratio as their diameters, i.e. also 1 : 3.

Considering only the outer pole, this must be capable of transmitting 3 lb./in. of torque, and with an effective radius of 1 3/32 in. the force to be transferred is $2\frac{3}{4}$ lb.

The precise coefficient of friction between the faces was not known, but a figure below 0.2 was assumed, for safety. Obviously, the clutch would not be deliberately lubricated, but it is impossible to rule out the chance of oil being present, considering the usual conditions applying in model installations.

A figure of 25 lb. axial thrust was eventually decided upon: readers will by now have noted the curious series of approximations I have used in place of mathematics; but in this case there are so many unknown factors that precision would be a little out of place. (It takes longer, too !)

This 25 lb. thrust is produced, of course, at each polar face, since they are in the same magnetic circuit. It now remains to calculate the coil necessary to produce it, and since a certain amount of obscurity seems to surround magnetic calculations, the reasoning will be shown in detail.

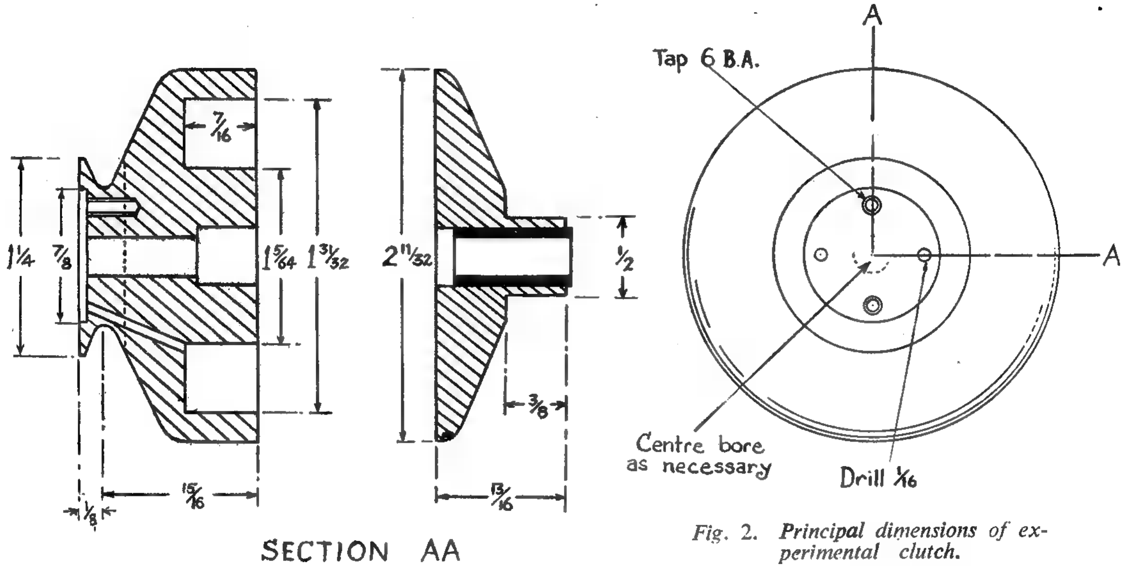


Fig. 2. Principal dimensions of experimental clutch.

The attraction between an electromagnet and its armature depends solely on the number of magnetic "lines" (a hypothetical quantity) connecting them. In practice the number of lines is generally quoted per unit area, and is called *Flux Density*. The symbol for this is **B** so that one talks of "a B of 10,000" (lines per sq. in.).

The pull in lb., **P**, can thus be specified by quoting **B** and the area of the pole face concerned in sq. in., **A**.

Thus, a suitable formula is

$$\mathbf{B} = \sqrt{\frac{72 \times 10^6 \times P}{A}}$$

Applying this to the clutch outer pole, where **P** = 25 and **A** = 1.25

$$\mathbf{B} = \sqrt{\frac{72{,}000{,}000 \times 25}{1.25}}$$

$$= \sqrt{1{,}440 \times 10^6}$$

= 38,000 (or so) lines per sq. in.

This flux density is analogous to current in an electric circuit, and

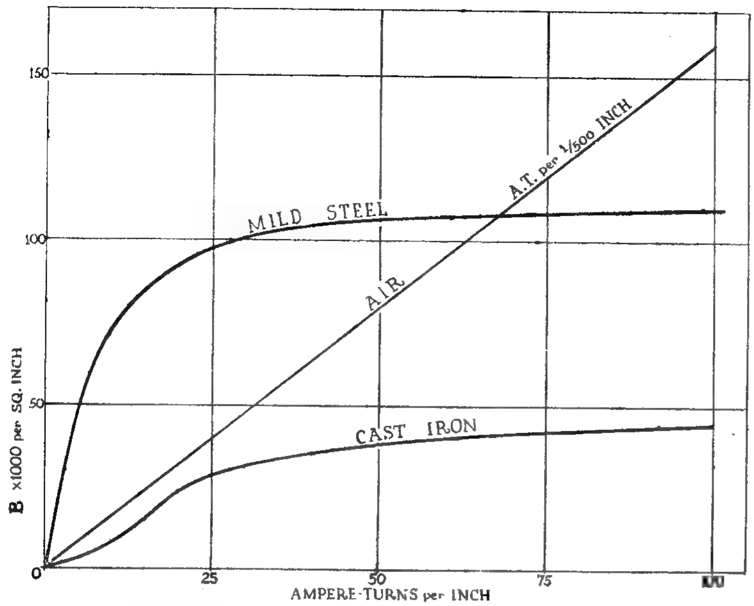


Fig. 3. A.T. required for a range of flux densities in various materials.

depends—as in Ohm's Law—on ■ Magneto Magnetic Force (M.M.F.) —analogous to E.M.F.—divided by ■ Magnetic Reluctance (R) analogous to electrical resistance.

What we are after in this case is the M.M.F., so we can rearrange the formula to read

M.M.F. = B × R

Just as in electrics, R depends directly on length of circuit and inversely upon the area. Unfortunately it also depends upon the flux density at which we wish to work because the *Permability* of magnetic materials varies not only between one type of iron and another, but also decreases as the flux density increases. Permeability is analogous to electrical conductivity.

In case the previous paragraph is no clearer than I think it is, Fig. 3 shows in graphical form the effect we are discussing.

Along the base is a linear scale of M.M.F. (which is quoted directly in ampere-turns) and at the left is a linear scale of flux density **B**.

It will be seen that the curves for two magnetic metals, cast-iron and mild-steel, are different in degree, though similar in form, in that both are quite definitely curved lines. It will also be observed that a given value of M.M.F. in ampere turns produces a much more profitable return in flux density for mild-steel than for cast-iron.

Remembering that M.M.F. has to be paid for in watts of electrical input, it is fairly obvious that only a phenomenal expenditure in battery power will enable either material to be worked beyond a certain point —the bend in the curve. This is approximately 90,000 lines/sq. in. for mild-steel and 30,000 lines for cast-iron. As we have decided on 38,000 lines, this can be efficiently produced in the former material, but if the flux density occurred at a point beyond the knee of the curve it would indicate that we were trying to push too many lines through the material and that we should have to increase the physical size of the clutch.

Similarly, it can be seen that cast-iron is useless for our purpose and should be rigorously avoided, together with all high alloy and hardened steels. Actually, the ideal material would be soft-iron in a grade specially produced for magnetic circuits, but this is difficult, so mild-steel is a fair compromise. Mild-steel is, of course, a loose term, magnetically speaking, and the result could perhaps be inaccurate by a factor of 2 at the worst. The particular piece of bar chosen for the present case was, however, selected for its diameter rather than its magnetic characteristics, and the final result seems to agree fairly well.

There is no easy test for the magnetic virtues of a piece of steel, but if one's scrap box is opulent enough to present a choice, then a small test bar turned from each alternative could be placed within a standard coil fed from a fixed E.M.F. The bar producing the greatest force on a standard armature would then be most useful. It would be necessary to turn the working end of each bar carefully flat, however, or the test would be invalidated.

Fig. 3 is interesting in showing the M.M.F. required to produce a given flux density in air. Note that the linear scale for air *is in* 1/500 *in.*

This shows very clearly why air gaps are to be avoided !

Entering **B** = 38,000 against the curve for mild-steel shows that 3.75 ampere-turns per inch of length of magnetic circuit are required.

In this case the circuit was assumed to retain the area of the outer pole (1.25 sq. in.) throughout, the reduction of the inner pole being ignored.

If, for mechanical reasons, it is necessary to vary the cross section significantly then the **B** for each portion is worked out separately and entered on the graph. This gives a certain number of ampere-turns per in. length for each portion, which are then added together to find the total ampere-turns required for the whole circuit.

Since we are ignoring this factor, the figure obtained of 3.75 ampere-turns per in. length is multiplied by the mean length of the magnetic circuit. This can be measured graphically on a longitudinal section of the clutch and is shown by the pecked line in Fig. 4. It is in this case almost exactly 3 in., so the total ampere-turns = 3 × 3.75 = 11.25 A.T. for the iron circuit.

It was cautiously decided to add in a factor to cover imperfect mating of the polar surfaces and the presence of an oil film at this point. A maximum gap of 1/1,000 in. was assumed, equal to 1/500 in. across both poles. Reference to the graph shows that for B = 38,000 Air requires 24 A.T. per 1/500 in. length.

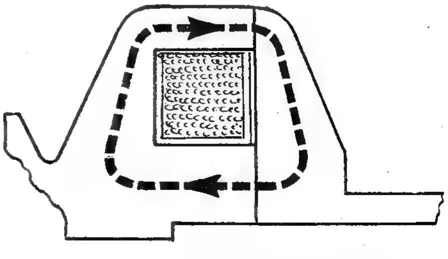


Fig. 4. Mean magnetic path through core.

Adding together the A.T. for iron and air gives [redacted] total of 35.25 A.T.

This can be divided in any desired way between turns and current, provided the product is correct, but in this case it was required to keep the current down to enable small dry cells to be employed as a source of power ; this means [redacted] consumption of not more than 100 mA. (0.1 A.).

The space available for winding is $\frac{7}{16}$ in. long with a radial depth of 0.445 in. The coil former was to be of appr. $\frac{1}{16}$ in insulation on all sides of the coil, and inset 1/32 in. from the working face to allow for wear. This left [redacted] winding space (actual) of 0.35 × 0.275 in. and 32-gauge enamelled wire was thought to be suitable. This can theroetically be wound to 6,890 turns per sq. in. and in practice perhaps to 80 per cent. of this figure.

The winding would thus have [redacted] total of 550 turns approximately, which gives [redacted] resistance of about 20 ohms.

A single cell giving a mean of 1.25 volts would thus produce a current of 0.0625 A, and this means an M.M.F. of 550 × 0.0625 A.T., i.e. 34.

This is admittedly less than the requirements calculated but the clutch was experimental, and it was convenient to use 32-gauge wire for testing purposes. Having measured the torque available in an actual clutch at varying values of current, the precise requirements could then be stipulated and [redacted] new winding made to suit if necessary.

Fig. 2 shows all essential dimensions of the clutch, and as stated previously this was turned by orthodox methods from [redacted] piece of mild-steel bar. A good finish is essential on the polar faces of both parts and these should mate perfectly when pressed together. This point should be checked with marking fluid in [redacted] the lathe has [redacted] slight tendency to produce [redacted] conical face. Apart from this, the finish should be smooth and accurate to the bore to an extent commensurate with the usual practice for a high-speed flywheel.

The slip-rings were converted from [redacted] surplus mechanism, but should present no problems to duplicate from raw materials.

Fig. 5 shows [redacted] suggested cross section. The base is turned from any thermosetting plastic—a Paxolin block would be very suitable—and two hard brass rings are pressed on against the shoulder. The rings should be secured by two thin pegs of brass in each.

The assembly is spigoted to the rear face of the clutch body, and retained by two 6-B.A. bolts tapped into the latter. Two $\frac{1}{16}$ in. holes are drilled diagonally through from the root of the annular coil recess, passing through the clutch body and slip-ring carrier. These holes are 180 deg. apart and at 90 deg. to the diameter on which the retaining-bolts lie. As shown in the drawing, a narrow slit is cut through the

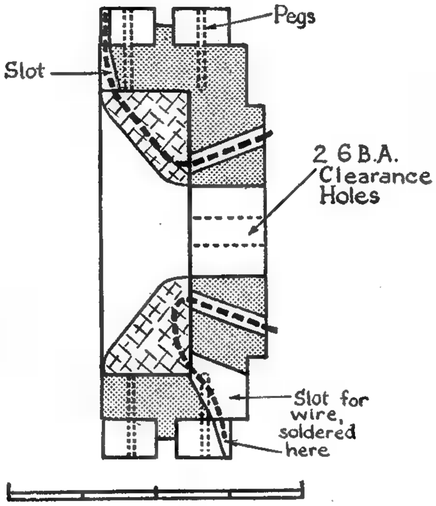
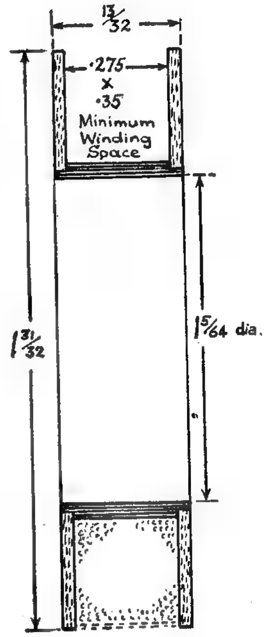


Fig. 5. Typical slip-ring assembly ; scale equals one inch.



Right—Fig. 6. Coil bobbin.

rim of the slip-ring carrier at two points, and these slits are extended into the sides of the two brass rings to take the connecting wires.

The Coil

In order to preserve the static balance of the assembly and protect the coil against centrifugal force, it is necesssry to make the winding fairly rigid.

The coil former was made (in the absence of fibre) from cardboard, which does very well provided it is well impregnated with shellac.

The two end cheeks were cut as rings of thin card and pressed on to a short cylinder made by rolling gumstrip around a bar to [redacted] thickness of about 1/32 in. A narrower strip of paper was then cut and gummed between the cheeks, bringing the total thickness to about 1/20 in. The complete former was soaked in thin shellac and thoroughly dried out. Fig. 6 shows the dimensions.

A simple winding rig was made up. This consisted of a shaft (provided with [redacted] handle) turning in bearings, and having a wooden cylinder forced over it. The length of the latter was made equal to the length of the coil former, and end plates of ply were screwed to the cylinder after the bobbin was placed in position. The purpose of these was to prevent the bobbin cheeks bulging outwards under the pressure of the wire.

The end of the wire was started through a needle hole in one end cheek, and after assembly of the winding rig the interior of the bobbin was painted with shellac. The wire was now laid on evenly and as far as possible in separate layers, each layer being painted with shellac. The turns actually counted were 540 before the bobbin was judged to be full. This brought the outside of the wire below the level of the end cheeks, and the remaining space was filled with gumstrip thoroughly shellaced. After a test for resistance, the outer end of the wire was carried down the outside of the end cheek, 180 deg. from the starting end, and laid in a groove cut with a razor blade. A thin slip of paper was varnished over the wire to retain it in position. The two ends of the wire were then cut to about 3 in. long, and about $1\frac{1}{4}$ in. of very thin plastic insulation (stripped from an old piece of wire) was then pushed home over each connection.

(To be concluded)

Electronic Organ

By C. C. Clarke

I NOTICE that there is considerable interest these days in electronic organs, more especially since the publication of my brother's (Mr. J. J. Clarke) effort in THE MODEL ENGINEER last year. The photographs accompanying this article show my own work on the subject; the article itself deals with some of the more outstanding details.

This work has taken me three and a half years to complete, and all the work entailed has been carried out in my boxroom, the size of which is approximately 8 ft. by 12 ft., containing my lathe, drill, workbench, etc. All machining was completed on a 2½-in. Exe lathe, including the cutting and hobbing of the toothed tone wheels. For this operation I made a dividing head from three gear wheels which I was able to procure. For the key contacts I made a press tool from scrap materials, and punched the necessary quantity from phosphor-bronze, the actual contact itself was recovered from scrap relay blades and riveted to the phosphor-bronze; this tool was then passed to my brother so that he could make his contacts.

Fundamentally, my instrument is on the "Hammond" principle, but with the following changes: The tone wheels are housed in twelve boxes, with seven wheels per box, viz.: 2-4-8-16-32-64-128 teeth, making a total of 84 tone generators. These wheels must be cut very accurately, and I found that the maximum amount of care was necessary in the cutting of these parts, as even a burr caused L.F. drumming on the higher frequencies. To overcome this difficulty I made hobbs by screwcutting and hobbed the periphery of the tone wheels. After my brother had heard my results he sent me his tone wheels for correction.

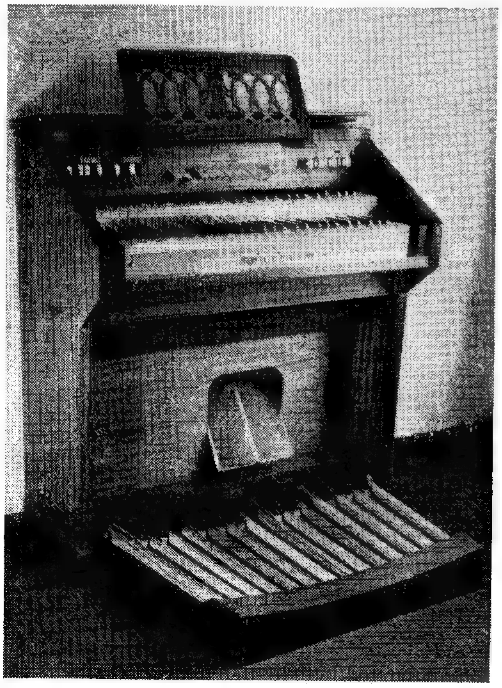
For driving power I use a 1/20 h.p. split-phase motor, via flywheel and torsion spring (to filter hunting) to a central mainshaft, thence to the twelve generator boxes, via rubber belts. Incidentally, as a point of interest, the belts are made from the packing ring of a 2 lb. Kilner preserving jar. I first cut them in half with scissors, and then sandpapered the outer edge, with the result that the belt is approximately 3/32 in. square, and I find, runs extremely well in "V" pulleys. The pulleys themselves are of brass and vary between 1½ in. to ¾ in. diameter. Tuning was effected by first getting "A" = 440 c/s from the B.B.C. Third Programme tuning note, and adjusting the pulley diameters to bring it into the correct pitch. In passing I would state that I made a small oscilloscope to check this point, also to make sure that I was receiving sine waves from my generators. The other boxes were then tuned by ear to the "A" box as I discovered that perfect "thirds," fourths" and "fifths" do not appear in the tempered scale. By my method of drive I obtain excellent and quiet running; all bearings are phosphor-bronze bushes.

Input transformers were the next problem, and after many trials and errors, I found the solution and produced the goods for myself, together with transformers and chokes for the amplifier unit, and then passed a duplicate set over to my brother.

The specification of my instrument is as follows:—*Great*—Pistons. No. 1. Full organ with reeds; No. 2. Great to 15th; No. 3. Strings with 16′; No. 4. Flutes and strings; No. 5. Keen strings; No. 6. Tibia with 16′; No. 7. Diapasons; No. 8. Select from harmonic drawbars on left of console.

Swell—Tabs. No. 1. 8′ flute; No. 2. 8′ and 4′ flute; No. 3. 16′ and 4′ flute; No. 4. Oboe; No. 5. Oboe and flute; No. 6. Trumpet; No. 7. Clarinet; No. 8. Bass horn; No. 9. Quint; No. 10. Full swell; No. 11. Diapasons; No. 12. Select

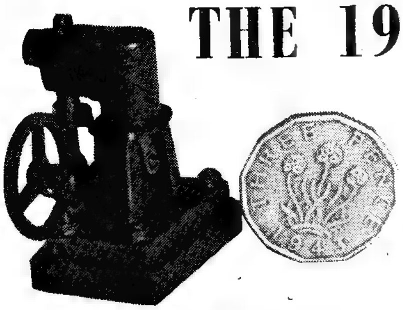
(*Continued on page* 114)



Left. The complete organ

Below. Close-up of the manuals.

THE 1953 SHEFFIELD EXHIBITION



This miniature steam engine, with a watch balance-wheel for flywheel, has a speed of around 5,000 r.p.m.

Reported by "Northerner"

THERE were quite a number of stationary steam engines at Sheffield this year, and one that created quite a lot of interest was a miniature vertical engine which was built by W. Cuckson from odds and ends of scrap material. It is single-acting, with a bore and stroke of only $\frac{3}{16}$ in., and is fitted with a piston-valve. The flywheel is a balance-wheel from a watch. Under compressed air, the little engine worked at a terrific speed, much to the admiration of the spectators.

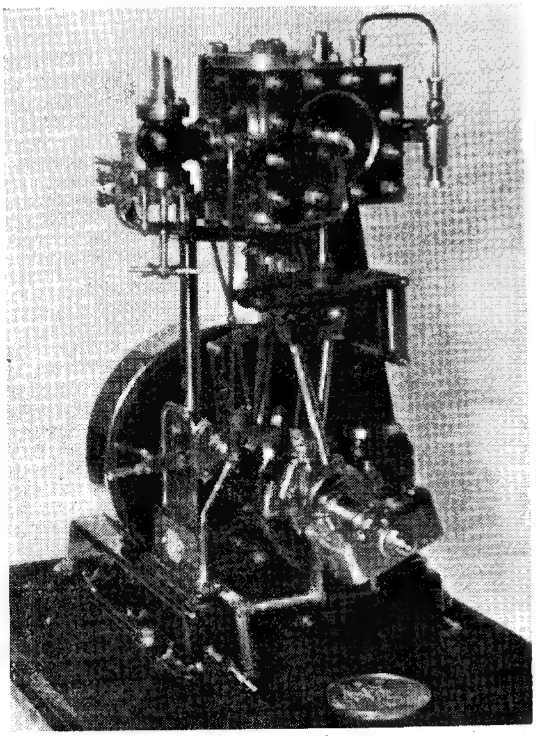
Concluded from page 65, *July* 16, 1953.

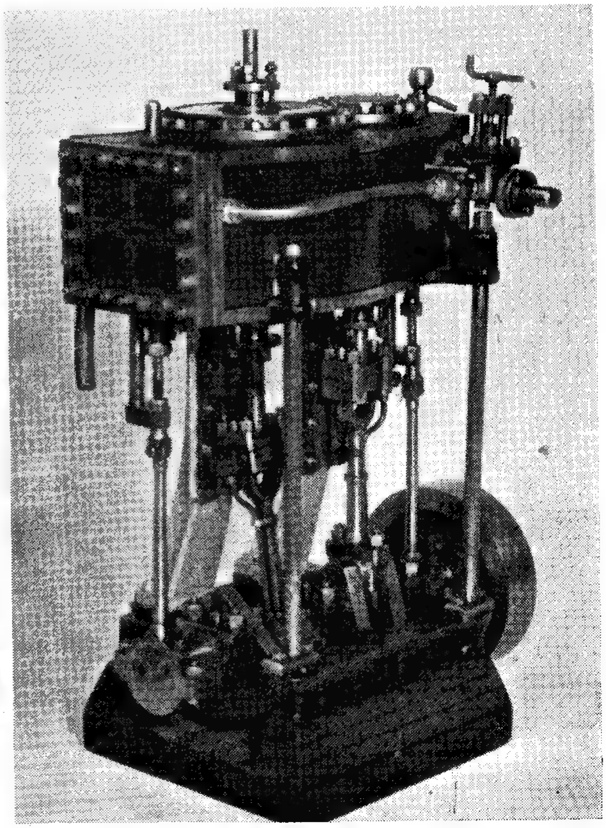
A vertical engine of another calibre was that built by A. Wood, of Manchester, which had a MODEL ENGINEER Exhibition bronze medal in its glass case, and bore the date 1922. The engine was fitted with Stephenson link motion reversing-gear, and had a governor on the crankshaft. The bore and stroke would be about $1\frac{3}{4}$ in. by $1\frac{1}{2}$ in., and it would be interesting to know more about the scale and the prototype. Neat pressure-release valves were fitted to the cylinder, and from a common oil-box, pipes were led to the bearings, including a drip feed to a cup on the cross-head, whence an oil-pipe led the oil to the big-end.

Another vertical engine was S. E. Watson's compound, of which the prototype was a ship-board engine for coupling to a dynamo for marine lighting. The cylinders were bronze, with cast-in valve-chests, and were about 1 in. and 2 in. bore by $1\frac{1}{4}$ in. stroke. A tail-rod was fitted to the L.P. piston, and the crankshaft had three bearings.

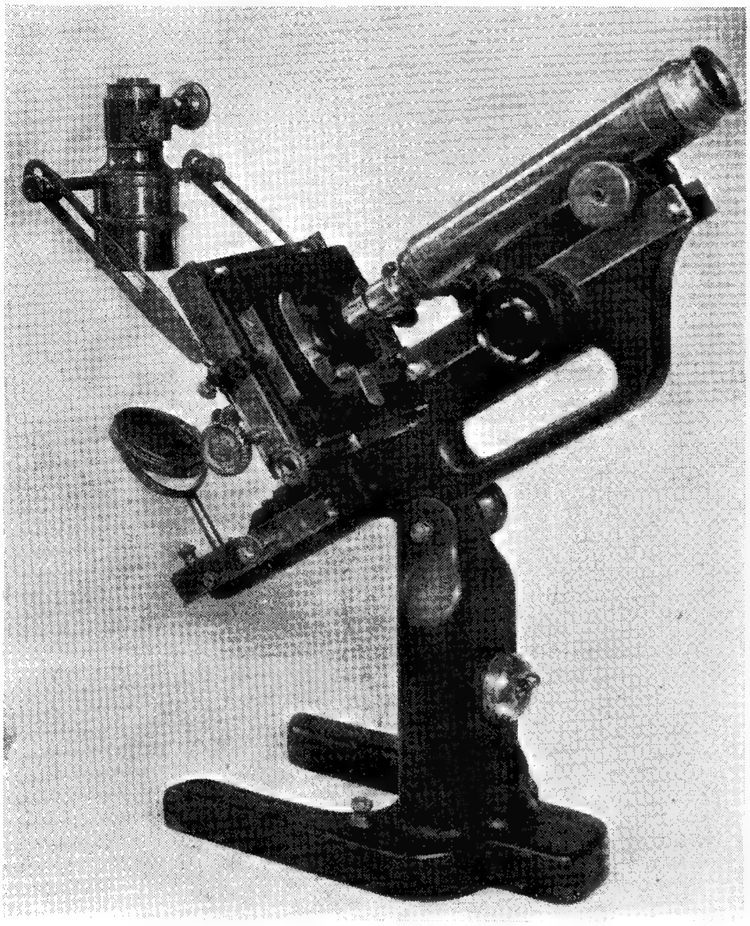
T. W. Birch had a pretty little horizontal engine, $\frac{3}{4}$ in. by 1 in., which he built some years ago at the age of sixteen. The valve-chest was over the mahogany-lagged cylinder, and the valve was driven from a rocking-shaft carried on the upper slide bars. There were four of these mounted on turned columns. A strap-type big-end was fitted, but the split brasses were adjusted by a screw and not by cotters. The finish was very good indeed, especially allowing for the youth of the builder.

C. W. Patterson, who hails from





A beautifully finished single-cylinder vertical steam engine built by A. Wood, of Manchester
Right—A compound steam engine for marine lighting by S. E. Watson of the home club



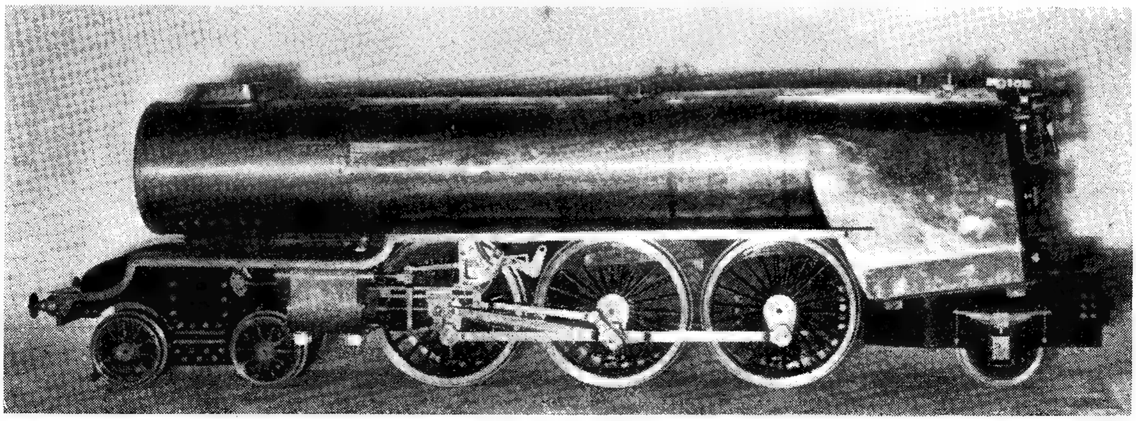
This microscope was built of all sorts of odds and ends by C.W. Patterson, using a home-made lathe and drilling-machine

Northern Ireland, exhibited a home-made microscope, mostly built from odds and ends culled from various sources. It incorporates scrapped radio parts, old camera lens mounts and other camera parts, Woolworth curtain rail, old brass tubing, and so on. For example, some of the milled knobs are Meccano gear wheels with the teeth partly turned away and rounded off—and, incidentally, all the turning was done on a home-made lathe and all drilling done on a home-made bench drill !

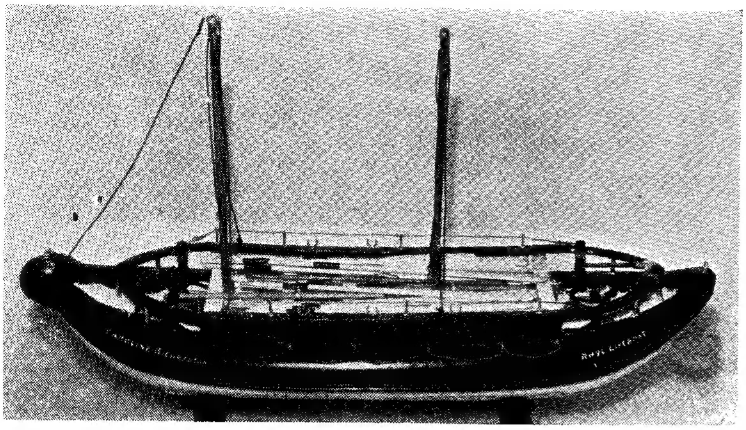
The lenses are, of course, the heart of the instrument, but Mr. Patterson was fortunate in obtaining these from an old microscope, with the objective lens from a micro-telescope. Optically, therefore, the instrument is very good indeed ; but this statement also applies to the mechanical parts and to the accessories, which owe so much to the builder's ingenious adaptation.

The stage has fully compound mechanical action, with a revolving slide holder, and the focussing spotlight can be pin-point focussed on or through the slide. Current for the bulb comes either from a battery fitted into the hollow foot of the instrument, which is built up in wood, or from the mains via a transformer. There is also an attachment for micro-photography.

Some excellent power-boats had come from members of the Huddersfield club, among them a steam yacht by Brian Littlewood, who is aged fifteen only. Considering the builder's youth, this was very good indeed, having a hull planked on ribs, with a superstructure mainly of metal. A very neat power-plant was fitted, consisting of an oscillating



I. R. Law's nicely made, though unfinished, small locomotive to the " Hielan' Lassie " " words and music "—his first attempt at this subject



This unusual model of a tubular lifeboat, built by the Rev. A. Everall, was described in last week's article

engine steamed by a centre-flue boiler and blowlamp. The finish was somewhat rough, and Brian will have to learn to exercise as much patience in this department as he evidently uses in others, but all things considered this was a very good effort, and I look forward to seeing more of his work in the future.

Another Huddersfield model was a 1/10 in. scale cargo steamer by C. Ledwidge. About 30 in. long, the hull was built "bread-and butter" fashion, and was fitted with a well-made single-cylinder engine and centre-flue boiler. There was plenty of deck detail, but the bollards and windlasses had been left in their naked brass, and the ventilators might have been a better shape. With her black hull, red boot-topping, and brown under-body, and with red and black funnel, the boat was very attractive. If anything, the paint and varnish were a bit *too* glossy, but in a working boat such a surface is easier to keep clean.

Finally, a *Hielan' Lassie*, that very popular "L.B.S.C." design, this time built by I. R. Law, of the Sheffield S.M.E.E. This is his first solo attempt at a locomotive, although he did help his father to build "1831" previously. Even with the *Lassie*, Law senior has had a small part, for he made the frames, but from there on all the work has been done by Law junior. She has been built to the "words and music," and the only snag was in the boiler, when, after brazing, there was a leak on the combustion chamber. The boiler had to be cut round the joint strap, and rebrazed with a new throat-plate and tube-plate. The second effort has been tested satisfactorily to 200 p.s.i., and the engine itself runs well on compressed air. In addition to the work shown, the chassis for the tender is nearly ready for assembly.

The Sheffield Ship Model Society, as usual, put on a magnificent show, and the Sheffield Model Yacht Club were well represented, too. In addition, the Sheffield Amateur Radio Club had a transmitting and receiving station working (as well as several other exhibits), and to listen to them in conversation with "hams" in other countries proved very interesting to the visitors.

So did the regular film shows provided by member George Wilkin. The subjects were varied, but one very popular one was the film he has made for the society, showing activities of members in their workshops. Even though it is incomplete and unedited as yet, and despite the fact that no member (that we noticed) bore any marked resemblance to Mr. Stewart Granger or to Mr. Errol Flynn, this film was an undoubted success. We commend the idea to other clubs who would like to show the ordinary public that most model engineering *is* done by ordinary blokes in ordinary circumstances of life !

ELECTRONIC ORGAN

(*Continued from page* 111)

from harmonic drawbars on right of console.

Pedal—Bass. Two drawbars to control mixture, the first gives the fundamental, and second and third harmonics ; the second adds the fourth, fifth, sixth and eighth harmonics.

There are two expression pedals ; the right-hand one controls volume of the swell manual and the left-hand controls both the great manual and the pedal organ. At present I am using only one amplifier (Williamson) and one R.K. 12 in. speaker, but feel that it would be more pleasing with two channels, treble, and bass, or possibly one amplifier and speaker for each manual. Perhaps some enthusiast would care to supply the writer with information on this subject. The case itself is primarily built from an old piano, which produced some good, well-seasoned mahogany, and the remainder is mahogany-faced plywood. The music desk is part of the fret that extended across the piano, and has been suitably framed and hinged to fold under the console lid when closed. I feel that this desk gives just the correct amount of relief to the otherwise austere ecclesiastical lines. The size of the console has been deliberately kept to a minimum in order to fit into the house ; for anyone interested, details are as follows : length 39½ in. width 21 in., height 42 in. Pedals are detachable and, when fitted, will extend the width to 42 in.

The case wood is left natural colour, and has been wax polished with bees-wax and turpentine, as I prefer this finish to the modern high gloss polish.

I have data on pick-up coils, transformers and chokes, which I have worked out and proved after many setbacks (as I am essentially a practical man), and can produce same if required. I have started a new generator assembly, which I hope to fit into the instrument at some future date. The boxes are as before, except for pulleys, and these are flat with webs, and vary from 4 in. to 2 in. in diameter, and are driven by one endless belt. This method gives a steady drive, and I hope to introduce frequency modulation, when required by a pulley running eccentrically in the main belt drive ; this to me sounds a much better tremulant than amplitude modulation.

I should appreciate it if any fellow enthusiast would care to see and hear the instrument, or write and exchange views on the whole matter.

The instrument was awarded a Bronze Medal at the 1952 "M.E." Exhibition, where many organists, including half of "Duplex," were able to demonstrate for the writer, who, unfortunately, is limited to simple chords.

HINTS ON D.C. ELECTRIC MOTORS

By F. Roberts

TESTING a motor in series with a resistance passing a heavy current, gives to it a characteristic which differs from its normal starting or running characteristics.

When starting with a starter, provision is made to supply the shunt field of a shunt or compound motor with line voltage while current is fed to the armature through resistances until the speed is nearly full speed, when all resistance is cut out and the motor is running on the line voltage. When started up with the orthodox starter, all motors will start in the right direction, even though interpoles or series field may be reversed.

When starting a motor through a resistance (as might be done when testing without a starter) the following may happen :—

Shunt Motor

If interpoles are reversed, motor may refuse to start or need a turn to start.

Compound Motor

If series field is reversed, the motor will start in its reverse direction owing to the heavy starting current passing through the fields influencing the direction, the very small drop in voltage across the armature making the shunt field negligible. A compound motor with its series field reversed has a low starting torque, takes a heavy current when starting, and when running, has a speed in excess of its rated speed. High speed is probably the easiest way to detect the trouble.

To test, open the shunt circuit and start up—motor will go backwards. Cut off quickly at main switch as soon as motor starts, in which case fuse should not blow. (Note:—When starting a compound motor where the motor is at a distance from the starting switch and the drop in the line is appreciable, the starter may be dispensed with.)

When a motor is doing its work with the interpoles reversed (quite a common occurrence) it is usual to find the brushes moved from their correct positions, sparking badly, and flashing over when a heavy load is put on. A sure way of detecting a motor working with interpoles reversed is to watch the brushes when the *main switch is cut off,* when the brushes will flare due to their being badly out of position for generating. Any or all interpoles can be cut out of the circuit if there is an earth present, to allow the motor to carry on until the trouble can be rectified. Similarly an earthed brush-holder can be cut out by running the motor with two or three sets of brushes instead of four.

Sparking at a brush is often due to insufficient spring pressure on the brush or on the one at the other side of the commutator. If no apparent reason for sparking at the brush is found, inspect the one connected to the other side. Heavy sparking may appear at the brushes of a generator or motor even when an ammeter inserted in the line shows normal current. When this occurs it is probably caused by commutation currents flowing from brush to brush, due to faulty position of brushes, or wrong connection; probably interpoles reversed.

To ascertain correct position of brushes by the neutral kick method, pass a small current round shunt fields, and with a voltmeter or milliammeter test on positive and negative brushes. When current is turned on to field you will get a momentary kick, and when switched off, a kick in the opposite direction; move brushes to position where least kick is registered on meter (isolate fields from brush gear while carrying out the above test).

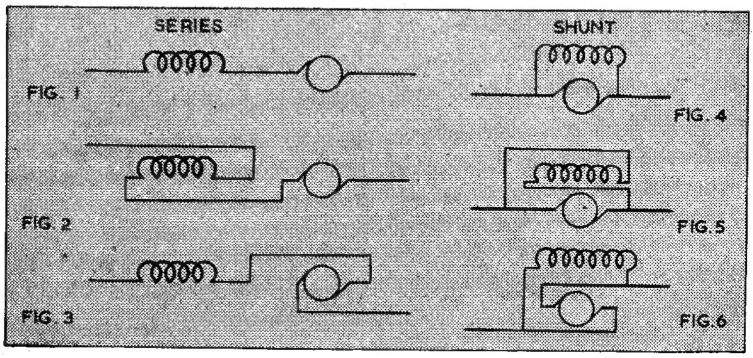
When no instrument is available, run motor light on full voltage and take speed with revolution counter. Position of brushes giving the slowest speed will be found correct. I have known cases where brush rockers have been moved to give higher speed. Higher speed will be obtained but at the expense of brushes and current.

There are different sorts of sparking at brushes, and after some experience the cause of sparking can be easily detected by the appearance alone. *Red ring* appearance round the commutator, especially when starting, or appearing only for short period, is caused by the breakdown of the mica between the commutator segments. It may be in only one place and may appear only when starting. This should always be carefully attended to or may start again in a day or two. Carefully scrape away the burnt mica until the smooth white mica can be felt or seen. In cases where the pitting is very deep, the commutator may have to be opened up and new mica fitted. If left unattended, it will eventually burn out a coil.

Open Circuit Spark

This is another easily detected trouble and often very easily cured. In appearance the spark usually has a green colour, the longer the motor has been running, the brighter the green, due to the copper segment burning away. (If left unattended the segment may be burned away very rapidly.) Another noticeable characteristic of the open circuit spark, is the way it leaps away from the brush, following the rotation of the armature, and often at a number of different points across the commutator. The condition of the burned mica at the open circuit is a sure sign of the fault, the mica being burned into brown globules, quite different from shorting mica.

With a heavily loaded armature running with an open circuit, the leaping of the spark as referred to, may carry the arc to the opposite brush and a flash-over will occur, although this seldom happens. In



wave-wound armatures as usually met with in four-pole motors, two open circuits will appear on the commutator although only one exists in the armature. In the small two-pole machines, the open circuit will show in only one place. If the broken wire can be located and repaired, that will be the end of the trouble. If the broken wire cannot be located and the open circuit is not intermittent, it is fairly safe to join the two segments between which the burning has taken place. In doing this it must be remembered that, in the unlikely event of the circuit joining up again, the short would burn out the armature. For that reason, when shorting two commutator segments, it is advisable to removed or cut away one or both ends of faulty coil from commutator.

To repair open circuit on a four-pole machine when broken wire cannot be located, disconnect end of coil from armature and solder a wire in its place. The wire will run from one side of the commutator to the other, taking the place of the coil and will cure the open circuit spark on both sides of the commutator.

Most open circuits occur close to the commutator under the binding. Many or frequent open circuits near the commutator usually means that the armature or commutator is loose on the shaft. This would only occur on reversing armatures such as cranes, etc.

Sparking Brushes

First, with a small piece of wood, put pressure on brush and if sparking stops, it is brush trouble only. Look to springs or leaves which apply the pressure to brush. Examine face of brush and if it is burnt badly it is serious, and must be attended to at once. If face of brush is smooth, it is not serious even though it sparks a lot. After cleaning a commutator with abrasive paper or carborundum blocks always clean all brush holders, or serious trouble may result from brushes being jammed in holder. To make a good job of cleaning a commutator, rub abrasive paper longitudinally all round it. This removes more mica than copper, hence its good effect.

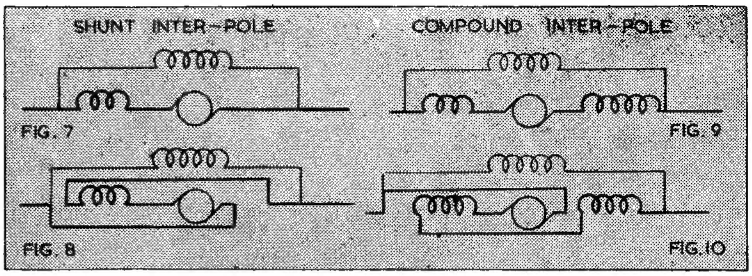


FIG. 7 FIG. 8 FIG. 9 FIG. 10

High Voltage Flash from Motor

If, in a shunt or compound motor working under heavy load, the contact to the armature is suddenly interrupted by a dirty patch of grease on the commutator, a high mica, or badly fitting brush, the sudden stop of current flowing through the heavy windings of the armature induces a high voltage current in the fields in the same way as in an induction coil; the many turns of the shunt field surrounding the few turns of the armature, and shunt coils being at the moment disconnected from the armature. The flash occurs elsewhere, usually where there is a large clean surface for the charge to collect before discharging—the same as the brass knob in an induction coil.

Generator Trouble

A generator will refuse to start generating if there is an open circuit in the armature. If the micas of the commutator are high, due to heavy current wearing out commutator segments, the brushes may be kept from making good contact with the copper segments to such an extent that generation will not commence.

Variation in Speed of D.C. Motor

Shunt motors can usually be speeded up to 20 per cent. or 25 per cent. above rated speed by inserting resistance in the field circuit, but such resistance should be automatically cut out when motor is shut off.

Resistance inserted in the *armature circuit only* will reduce the speed of a motor, but the speed varies with the load, and a shunt motor loses its characteristic constant speed.

To Obtain A.C. from a D.C. Motor

Choose a motor which has room between armature or commutator and the frame to fit two insulated rings. When these are fitted it is only necessary to connect one ring to a commutator bar and the other ring to the bar diametrically opposite. For a 230 V motor, the a.c. voltage will be approximately 169 V. A transformer will be necessary to bring up to 230 V.

460 V Motor Running on 230 Volts

Motor will run at one or two hundred revolutions under rated speed. Connect field in parallel (to obtain full field strength) and motor will run at half rated speed.

Reversing Direction of D.C. Motor

Taking the case shown in Fig. 1 (series); to reverse, change over field as in Fig. 2, or change over armature (see Fig. 3). If both field and armature are reversed, the direction of armature will remain the same.

Referring to Fig. 4 (shunt); to reverse, change over either field (see Fig. 5) or change over armature as in Fig. 6. Most modern shunt motors are fitted with interpoles. To change direction of rotation for motors of this type change over the armature leads which include the interpoles. Do this also for compound motors. Any other way of reversing is liable to be difficult and should not be attempted unless in a test room. For shunt motors with interpoles, see Figs. 7 and 8. For compound motor with interpoles, see Figs. 9 and 10.

To test a small single-phase a.c. motor when d.c. only is available, apply current source to motor through a resistance (fairly heavy

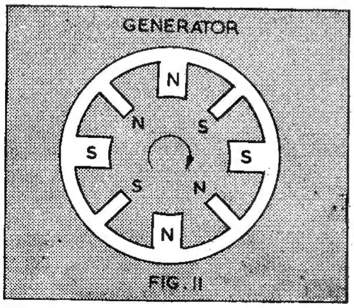


FIG. 11

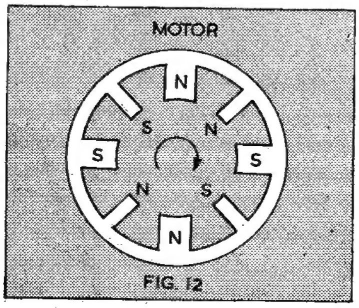


FIG. 12

current). Touch motor terminals and disconnect quickly. If in order, motor will turn slightly when the circuit is broken, showing that it is O.K., also the direction of rotation.

To reverse small a.c. motor at will, disconnect starting winding leads from terminals and take to a change-over switch, wired so that the direction of current through starting winding can be reversed. This, in addition to accomplishing the reversal of motor, makes it absolutely foolproof since the change-over switch may be moved about at will while the motor is running without harm.

Polarity of Interpoles

Generator: same as main pole ahead (Fig. 11). Motor: same as preceding main pole (Fig. 12).

To test for incorrect wiring between starter and motor, put main switch on and off, and if a flash is noticeable, the line and armature must be interchanged.

When a number of connections are made to generators or motors that are periodically disconnected for cleaning or overhaul, it saves time, and the probability of mistakes, if the terminals are painted with coloured paints, preferably keeping to a colour system throughout.

Too much oil is the cause of many motors and generators failing.

Ball bearings should not be stuffed full of grease. If properly greased, they will run from three to five years without attention.

Low voltage heavy current generators, such as are met with in welding machines, require very soft brushes; the fitting of ordinary hard carbon brushes can cut down the current to such an extent that heavy welding cannot be performed.

Moving the brush rocker of a four pole d.c. motor through a 90 deg. angle, will reverse direction of rotation and, on a generator, will reverse the direction of current, but this must not be done where there are interpoles.

Railway carriage generators for charging batteries operate by a simple friction device which carries the brush rocker round to its correct position in either direction of rotation.

A very useful type of a.c. motor for a small lathe is the repulsion induction type with the movable rocker-arm for reversing direction. A handle applied to the rocker-arm will enable it to be moved to any position between limits of one direction and the other, with varying speed; the torque increasing considerably as speed decreases—very useful in lathe drive.

WITH THE CLUBS

The Society of M. and E.E.

There will be a meeting at Caxton Hall on Saturday, July 25th, at 2.30 p.m. Mr. D. G. Webster will give a talk on his G.W.R. "Dean" single-wheeler locomotive. It will be remembered that the bogie of this locomotive appeared in the Loan Section at the last "M.E." Exhibition when the beautiful workmanship was much admired. Visitors will be welcome.

Full particulars of the society may be obtained from the Secretary, E. C. YALDEN, M.C, 31, Longdon Wood, Keston, Kent.

The M.P.B.A.

Hydroplane races for the Hispano Suiza and Ford Trophies will be held at the lake, Verulamium, St. Albans, on Saturday and Sunday, August 8th and 9th.

Saturday, August 8th.—Hispano Suiza Trophy—10 c.c. boats only. Commencing 2 p.m.

Sunday, August 9th.—Ford Trophy—All classes. Commencing 12 noon.

Messrs. B.M.R.C.A. (Hispano Suiza) have generously donated prizes in the form of replica cups for the Hispano-Suiza race, and various other prizes will be available for the Ford Trophy race.

Competitors intending to enter these events should send their entries IN ADVANCE to the Hon. Secretary, closing date Wednesday, August 5th.

Entries will be accepted by post, telephone, or personally, but no entries can be accepted on the day.

Hon. Secretary: J. H. BENSON, 25, St. Johns Road, Sidcup, Kent. Tel.: FOOts Cray 7428.

The "Curly Circle"

Circulo Curly de Aficionados a la Mecanica en Miniatura ("Curly Circle" for short). The above association has been formed in Buenos Aires with the object of furthering the hobby of small power engineering. A call is hereby made to all interested persons within comfortable distance.

President: RAUL A. NEGRETE, Calle Valentin Vergara 2738, FLORIDA-FCNGBM, Argentina.

International Radio Controlled Models Society

The annual international contests for radio controlled models will be held at Southend-on-Sea, Essex, on July 25th and 26th. The contest for radio controlled model boats will be held on Saturday, July 25th, and the contest for model aircraft on Sunday, July 26th. The radio control of model boats is becoming more popular than ever, and it is expected that a large number of competitors, both from Great Britain and from overseas will take part in this year's events. Further details and entrance forms, will be sent on application to the Hon. Contest Publicity Secretary: R. ING, 36, Sunny Gardens Road, Hendon, London, N.W.4.

The Society of A.E.M.E.

The Society of Amateur Electrical and Mechanical Engineers was formed in Derby in April, 1953, the object being to meet the need of the many electrical and mechanical engineering craftsmen who are in the group known as "amateurs." All members must be actively engaged (not professionally) in the branches of engineering referred to. Amongst present members there are builders of small scale locomotives, refrigerators, clocks and chimes, etc.

The number of members has been limited, and interested parties should apply to the hon. secretary for details.

Meetings are held monthly on the first Thursday in each month unless otherwise notified.

Since the inaugural general meeting in April, visits have been paid to the Granville Colliery, the Marston Brewery, and the Derby Power Station.

Hon. Secretary: W. K. WALLER, 37, Douglas Street, Derby.

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July 26th.—Bedford M.E.S.—Regatta at Wicksteed Park, Kettering.

July 27th, 28th, 29th, 30th, 31st, August 1st, 3rd, 4th, 5th, 6th, 7th, 8th.—Chichester and District Society of Model Engineers.—Exhibition at Adcock's Showrooms, East Street, Chichester Open 5 p.m. first day, 10.30 a.m. other days.

August 1st, 3rd, 4th, 5th, 6th, 7th, 8th.—Taunton and District Society of Model and Experimental Engineers.—Exhibition in Vivary Park, Taunton.

August 2nd.—South London M.E.S.—Regatta at Brockwell Park, London, S.W.

August 8th and 9th.—M.P.B.A.—Hispano Suiza and Ford Trophy.—Regatta at Verulanium, St. Albans.

August 12th, 13th, 14th, 15th.—Exmouth & District Society of Model & Experimental Engineers.—Exhibition at the Y.M.C.A. Hall, Victoria Road, Exmouth.—To be opened at 7.30 p.m. on Wednesday, August 12th. Opening 10 a.m.-9 0 p.m., Thursday. August 13th.—Saturday, August 15th inclusive.

August 15th.—Aldershot and Farnborough M.E.S.—Regatta at the Fleet pond.

August 16th.—Southampton and District M.E.S.—Regatta at Ornamental Lake, Southampton.

Correction

We regret that an error occurred in the advertisement for the E.W. lathe by Messrs. J. F. Stringer & Co. Ltd. in the July 9th issue of THE MODEL ENGINEER. The $2\frac{1}{2}$ in. $\times$ 8 in. convertible lathe announced has been discontinued, and the specification of the lathe should read $2\frac{1}{2}$ in. $\times$ 10 in.

The Annual Subscription is £2 2s. 0d., post free, to all parts of the world.

The Managing Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Correspondence and manuscripts should not be addressed to individuals, but to the Managing Editor, THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.